Complainants' Exhibit No. 2. James D. Maher, Commissioner.

State of New York:

W. J. Sullivan.

Report of the New York Bay Pollution Commission to Hon. Frank Wayland Higgins, Governor, March 31, 1905.

Commissioners: Daniel Lewis, Chairman; Olin H. Landreth, Myron S. Falk, George A. Soper, Louis L. Tribus, Secretary.

Transmitted to the Legislature May 1, 1905.

Compliments of the New York Bay Pollution Commission. Louis L. Tribus, C. E., Secretary, 84 Warren St., New York City, Oct. 1905.

(Here follows map marked page 1, Exhibit No. 2.)

3 STATE OF NEW YORK:

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4 STATE OF NEW YORK:

No. 39.

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Report of the New York Bay Pollution Commission to Frank Wayland Higgins, Governor of the State.

Commissioners: Daniel Lewis, Chairman; Olin H. Landreth, George A. Soper, Myron S. Falk, Louis L. Tribus, Secretary.

Hon. Frank Wayland Higgins, Governor State of New York, Albany, N. Y.

SIR: The New York Bay Pollution Commission respectfully reports to you herein the main facts concerning its researches and its recommendations.

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6 Causes Leading to Appointment of Commission.

The State Department of Health, having for years noted with anxiety the increasing pollution of New York harbor, due to the discharge into its waters, of sewage and factory wastes of all kinds from the different boroughs of the city of New York, the city of Yonkers, and the cities and towns in the State of New Jersey, situated along the banks of the Hudson river, New York bay and their tributaries and estuaries, and this pollution having culminated in the proposed construction of an immense sewer to discharge the waste from a large territory in New Jersey, not contiguous to the waters of New York bay, brought the matter to the attention of Governor Odell, who thereupon invited legislative action.

The Passaic river (lying wholly within the State of New Jersey) but flowing into one of the estuaries of the harbor, became years ago so foul with sewage coming from the cities along its banks, that a serious nuisance was created, menacing the health and comfort of the adjoining and lower communities. It discharges into the tidal waters of Newark bay, which opens in turn into Staten Island sound and Kill von Kull; thence into New York bay, respectively the lower and upper portions, though as yet these latter waters have not evidenced a condition where annoyance is strongly apparent;—Newark bay having acted as a diffusing, settling and partial purification basin;—but with the possibility that a nuisance will be created.

The State of New Jersey had authorized the preparation of plans and the issuance of bonds for constructing a large trunk sewer which, when completed, would free the Passaic river and Newark bay in large measure, from the sewage of Newark, Paterson, Passaic and many smaller communities within the drainage area.

7 The plan proposed to conduct all this sewage across Newark bay; thence across the city of Bayonne, and empty it into New York bay within the State of New Jersey, but near the interstate line, on the margin of the deep water channel, at a point about one mile north of Robbins Reef light.

There was thus contemplated the discharge of the house wastes and factory refuse from a population of between one and two millions of people, directly into New York harbor at one, two, or three points, located near together.

Opposition to the project which has developed in the State of New Jersey need not be considered in this report, though upon various grounds it has been considerable.

Legislative Action, New York State.

The subject was brought to the attention of the New York Legislature of 1903, which forthwith enacted Chapter 539, becoming a law May 11, 1903, entitled "An act to authorize the appointment by the Governor, of a commission to investigate certain threatened pollution of the waters of New York bay and making an appropriation for the expenses of such commission."

The salient points of said act being (abstracts as follows):

Section 1. Authorizing the Governor to appoint a commission of five members to serve without compensation.

Section 2. Directing said commission to confer with the authorities of the State of New Jersey; to take testimony of witnesses and make such investigations as should seem desirable to determine the character of the threatened pollution, if any, and the means necessary to effectively prevent the same.

Section 3. Giving power to said commission to administer oaths, subpœna witnesses, and such other powers as Article 3 of the Legislative laws gives to Legislative committees; and requiring the commission to report to the Governor the result of such investigations and its recommendations as to legislation, etc.

Section 4. Appropriating moneys for the necessary traveling and other expenses of the commission.

Section 5. Making the act effective at once.

Work of the Commission.

On June 2, 1903, the appointments of the commissioners were forwarded, and on the 30th of that month the first meeting was held, at which an outline of procedure was prepared and assignments made to the different members, of subjects for their special investigation.

As appendices to this report will be found in full these special reports, which have been fully discussed at the meetings and from which, with testimony taken at public hearings and joint conferences with the Passaic Valley District Sewage Commission have been derived the conclusions.

The Special Subjects are as Follows:

Appendix 1. Tidal action and river flow in harbor of New York, by Commissioner Myron S. Falk.

Appendix 2. Present sources and estimated quantities of sewage coming from different communities in and about New York harbor, by Commissioner Louis L. Tribus.

Appendix 3. Sanitary and bacteriological analyses of New York harbor waters and fisheries; and industries affected by pollution, by Commissioner George A. Soper.

Appendix 4. (A) The history, laws, reports and plans of the New Jersey project, and (B) ocean disposal as a possible solution for all the metropolitan sewage nuisance, by Commissioner Olin H. Landreth.

Appendix 5. Needs of the metropolitan district as a whole and desirability of joint State action, by Commissioner Daniel Lewis.

Appendix 6. Legal rights and powers of New York State to prevent pollution, by Attorney-General John Cunneen.

In addition to these special reports there will be found herein:

Appendix 7. Law authorizing appointment of commission.

Appendix 8. Proposed Legislative bill.

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Appendix 9. List of meetings held by the commission and special features considered thereat.

Appendix 10. Statement of disbursements.

Appendix 11. List of those who have rendered special assistance to the commission.

Map, showing: Tidal action New York harbor (see Appendix 1).

Sewer outlets at margin of harbor waters (see Appendix 2).

Shellfish beds and position of points from where water and shellfish samples were taken for analyses (see Appendix 3).

Passaic valley sewerage district and proposed location of outlet (see report of New Jersey Passaic Valley District Sewerage Commission).

There also will be filed at Albany full minutes of the different meetings, both in executive session and in joint session with the New Jersey authorities, and a copy of the report of the Passaic Valley District Sewerage Commission, and testimony of experts retained thereby.

10 In connection with the joint investigations, a number of personal studies have been made by different members of the commission, of the most recent systems of sewage treatment and disposal, so that possibilities of other means of disposal than at present planned by the State of New Jersey could be intelligently considered, though it has not been thought proper to suggest any special course for New Jersey to follow.

Tidal Conditions, New York Harbor.

Assuming that the Passaic valley trunk sewer has been constructed with one, two or three outlets north of Robbins Reef light, the action of the tidal currents would very largely determine the question whether the sewage discharge would be likely to become an offense to the senses or not, even considering that the sewage would ultimately become diffused, and that the water in the harbor is sufficient to safely and rapidly dilute so large a concentrated flow. If the sewage should be discharged at a uniform rate throughout the twenty-four hours, as has been contemplated by the Passaic Valley District Sewerage Commission, it is unquestionable that some of the sewage would be carried by the inflowing tide northwards into the Hudson and East rivers, and on the outgoing tide southward to the shores of Staten Island. If the sewage should be retained so as to have the outflow only on the stronger run of the ebb tide, the percentage to go northward would be greatly reduced, helping the upper harbor, but the percentage reaching the shores of Staten Island would be greatly increased; and though the total quantity of sewage in twenty-four hours would be no greater, it would be discharged in practically eight instead of twenty-four hours; so that the quantity at any given time during the outflow would be three times as great as on a continual flow basis.

11 A matter of much importance in considering the dispersion of sewage is the question of the under-run of salt water beneath the fresher waters from the Hudson. The difference in specific gravity between the two waters may be as high as 2½ per

cent. There is thus a tendency for the salt water to force itself up the river for a considerable distance and to remain stagnant while the fresher waters follow their way down to the sea. This tendency is marked at low water stages in the river. It does not seem improbable, therefore, that some of the sewage discharged at from 30 to 40 feet beneath the surface would even during a strong ebb tide for the upper layers of water encounter strong up-stream currents and be, therefore, carried well up the bay and even some distance up the Hudson river. The full effect of this under-current is not known, but its existence has been noted and it might almost totally vitiate the efforts to dispose of sewage from the proposed Passaic valley trunk sewer by means of tidal carriage and diffusion. It might be that for some years the collecting of this sewage in the potholes or basins of the bay and the river would not create a nuisance noticeable on the surface or in the great body of water, but it is certainly desirable to guard against such a possibility.

In any case, the subject is one more largely of tidal phenomena than straight diffusion, except as to the great probability of a local nuisance being created near the outlet pipes;—one which, if created, would be apparent from boats passing along the main channel to and from Kill von Kull; the ferry lines between Manhattan and Richmond, the many vessels anchoring on the west side of the main ship channel, particularly in Summer, and to many of the steamers and excursion boats passing in and out of the bay.

12 The expert advisers of the Passaic Valley District Sewerage Commission unite in the opinion that on a twenty-four-hour outflow the diffusion of sewage would be so great immediately on its entering the waters of the bay as to create no nuisance. They are less certain as to the effect of having the discharge during the shorter number of hours so as to make more use of the ebb tide. In the latter case they think there might be trouble, in the former they estimate that there will be none; scarcely a safe ground to stand on in a vital question.

It has been practically impossible to secure exact figures as to the tidal flow phenomena, though United States government engineers some years ago conducted a series of observations and tests. From them and such other data as have been secured, it seems probable that a quantity of water not far from twelve to thirteen billion cubic feet enters the upper bay at each of the tides per day. Of this amount, the approximate figures may perhaps be:

4,250 million cubic feet into the East river;

6,750 million cubic feet into the Hudson river;

1,750 million cubic feet into the Kill von Kull.

The areaas of the tidal basins receiving this flow are approximately as follows:

Kill von Kull, Newark bay, and the Passaic and Hackensack rivers about 14.2 square miles.

The Upper bay about 21.6 square miles.

The East river about 4.5 square miles.

While the Hudson river has a tidal area equal probably to all the others combined.

The ebb tide coming down the Hudson meets the ebb tide coming eastward out of the Kill von Kull; they both reach in and
13 strike Staten Island between Stapleton and Clifton, at a point distant about three to four miles from Robbins Reef light. It then makes along the shore and traveling along the beach makes Forth Wadsworth. At this same time there is also an ebb coming from Arthur Kill (or Staten Island sound) and Raritan river which, striking the main current, tends to throw it to the eastward again in the lower bay. In calm weather the force of the main tide through the Narrows may reach as far as Swinburne Island and Orchard Shoal. Strong winds at all times tend to deflect the currents somewhat.

The first effect of the flood through the Narrows is to strike the shore of Staten Island a little to the north of the point where the first effect of the ebb is felt. The second effect of the flood is reaching into the flats of the Upper bay to the west of Robbins' Reef. The third is to flow into the Kill von Kull, and the fourth and final effect to flow into the Hudson and East rivers. After the first of the flood the tide also travels up on the Brooklyn side. It is probate that in calm weather the maximum effect of the flood tide is felt on the northwest side of the Upper bay.

The tidal ebb is detected by discoloration of the water five or six miles from the outer face of the bar; sometimes even outside of Sandy Hook lightship, but there seems to be little concentration of effect, at that distance from the Narrows.

The published Government reports give the maximum ebb velocity of the current in the Narrows at 1.5 knots and the maximum flood 1.2 knots per hour. In the Hudson river off Thirty-ninth street these figures are respectively 2.7 and 2.0 knots, and in the East river off Twenty-third street, 2.0 and 1.8 knots. Estimating a constant velocity of discharge during the various tidal periods of the day, the average ebb velocity at the Narrows would
14 reduce to 1.61 miles per hour, the average flood velocity to 1.48 miles per hour.

It is probable that some of the sewage which reaches the radius of action of the active tidal ebb flow, will ultimately be carried out of the harbor to the ocean, though taking several days in the process, but it is not so evident that all of the sewage or even that the major part of it, will reach such radius of action, so would remain in the harbor for gradual putrefaction and breaking up.

If the diffusion and rapid oxidation should not be so great as is anticipated by the Passaic commissioners, it is not difficult to imagine the creation of a condition of affairs decidedly unpleasant to the senses, if not necessarily detrimental to health, particularly along the shores of Staten Island and in the path of many vessels.

Present Pollution of New York Harbor.

The Hudson river receives sewage from many of the larger cities and towns of New York State, which it discharges into the harbor of New York, but being affected by tidal action as far north as Albany, and the combined fresh water and tidal volumes so greatly

exceeding the total quality of sewage, no general nuisance has as yet been created, nor does such seem likely to arise in the near future. Some of the streams tributary to the Hudson do present, however, very serious conditions. The cities along the Hudson, south of Albany, are daily pouring their millions of gallons of filth into the river, but not creating as yet any noticeable nuisance, except near the outlets. To what extent this sewage undergoes organic change by the time it reaches New York harbor is a question difficult of determination. If a complete change does not take place,
15 so thorough a diffusion does occur as to prevent any serious nuisance being apparent. The condition is not so certain, however, as to the outflow from the several hundred sewers entering New York harbor at both sides of the Hudson river from the Yonkers line southward; in the various kills and bays, and in Long Island sound within the radius of action of the harbor's tidal flow. It should be said in fairness, that at the present day the waters of New York harbor in general are not so polluted as to be offensive to the senses, though such is the case in some of its estuaries and smaller bays.

Without elaborate study, no one can estimate with precision, however, the exact degree of pollution permissible, before the conditions would reach a serious stage. The following table gives estimates of the present normal daily sewage flow from existing sewers; that proposed (based on present conditions) from the Passaic Valley trunk sewer and that from another large system lately constructed, which will accommodate South Orange and other communities in that portion of New Jersey, as well as a considerable portion of the city of Elizabeth.

From locality.	Estimated present population.	Estimated daily dry weather sewage flow in gallons.
Communities on shores of New York Harbor	4,470,000	447,000,000
Part of Elizabeth and South Orange District	80,000	8,000,000
Part of Passaic Valley District	500,000	50,000,000
Totals	5,050,000	505,000,000

On the map accompanying this report has been indicated the outlet points of all sewers of which information could be secured, the table in Appendix 2 showing their respective discharges. Most of these accommodate storm flow as well as sanitary sewage.
16 Ordinarily, of course, they only handle house and manufacturing wastes and some street washings; but immediately following rain storms, a great deal of additional filth from the streets reaches the harbor, in quantity probably averaging some 350 million gallons per day. The normal pollution however may be considered, to be chiefly the outflow of house and manufacturing wastes, rejected by about five million inhabitants of New York and neighboring communities.

The saving feature of the present discharge is that it debouches at so many different points that very thorough dilution occurs and any great localized nuisance is avoided,—a condition which could not

be predicted if the whole flow should be gathered into five or six outlets, each having the capacity of the proposed Passaic Valley trunk sewer.

It must be borne in mind in considering all such matters as those made the subject of this report, that the best or even average conditions are not those which govern the case, but that the worst possible conditions which may arise are those which should determine conclusions; consequently, it is not the immediate plan of the Passaic Valley District Sewerage Commission which needs to be thought of as possibly dangerous, but the ultimate plan contemplated and not only with regard to the New Jersey project or projects, but concerning all sewerage works having present or proposed future entrance into New York Harbor and its bays or branches. In questions of this character, years must necessarily intervene between the initiation and the consummation of projects, so that future nuisance must be anticipated and relief measures considered many years before either the nuisance has been created or the relief can be given.

17 Sanitary and Bacteriological Condition of New York Harbor and Its Fisheries and the Industries Affected by Pollution of the Waters.

From the studies of the commission it is evident that the present pollution of New York Bay, although not great, is distinctly measureable by chemical and bacteriological analyses, and careful studies of the relative proportions of sea and fresh waters in the bay and rivers about New York show that the sewage of New York city is not promptly flushed out to sea, except perchance during time of heavy freshets from the Hudson. The water of the incoming tide is not ordinarily much purer than the water of the outgoing tide, as noted in the Upper bay, yet it is probable that most of the sewage now entering the harbor is disposed of in the harbor itself by the lower orders of animal and plant life found abundantly in the waters, the chief effect of the tide seeming to be the production of currents whereby the sewage becomes mixed and diffused. Without special and experimental studies it is impossible to estimate with clearness how large a proportion of sewage and other organic matter can be emptied into the harbor without killing these forms of life which now destroy it. Immediately follow- their destruction would unquestionably develop an intolerable nuisance. It is estimated that every 24 hours there is deposited from the sewers of New York and vicinity an equivalent of 1,047 tons of dry sludge, about one-half of which may be assumed to be organic matter.

The oyster beds of New York bay are almost exclusively found on the southeast side of Staten Island and in Gravesend bay. Most of these shellfish beds are now free from dangerous pollution,
18 though some of them are found to be nearer sewer outfalls than is wise or proper.

Analyses of oysters and clams made under the direction of the commission show that shellfish grown or immersed for some hours in polluted water, become polluted themselves. This fact is of peculiar

importance, for the custom is almost a universal one of taking oysters from their natural beds and depositing them for a few hours or days in the mouths of fresh-water streams adjoining the coast; streams which are almost invariably seriously polluted, the object being to give the oysters a so-called "drink" which results in bleaching and bloating them.

Fish caught in the harbor do not seem to have given evidence of impairment of their meat due to polluting matters, except at certain times in the past from special causes such as the outpouring of petroleum and other industrial wastes.

It is probable that about 1,000,000 bushels of market oysters and clams are taken from the waters of New York harbor annually, at an approximate valuation of about $900,000. The fishing of importance in the same waters, practically confined to the catch of shad in the very short spring season, which amounted in 1901, the heaviest year since 1888, to less than 3,500,000 pounds, valued at about $110,000. From these figures the question of interference with fisheries cannot be considered a very serious one from the industrial point of view should the whole industry disappear. Should disease, however, be disseminated from the eating of polluted shellfish before such time as the industry shall disappear from New York harbor, the consequences might be very serious.

There have been taken during the past season about fifty samples of water from the harbor, at points between the Battery and
19 Coney Island on one side, and the Battery and Raritan bay on the other. These were analyzed with the result that colon bacillus, an invariable accompaniment of sewage was generally indicated by the "presumptive test." These analyses were made in the Prospect Laboratory, Brooklyn, by one trained in water analysis. A few specimens were also sent for examination to the Bender Hygienic Laboratory at Albany. Some fifty-one specimens of oysters and clams were also taken from their natural beds and examined in a similar way for evidence of the colon bacillus. The results show that wherever the waters indicated pollution, the oysters were themselves found to share in the pollution; while in general the samples taken from the localities where the pollution of the water was not appreciable, were wholesome: the samples taken from the "drinking grounds" showed greater evidence of pollution than those from the natural beds.

Chemical examination of the waters made for this commission and by others show distinct evidence of pollution both at ebb and flood tides, particularly in the Upper bay, though the examinations do not warrant the opinion that the water is everywhere and at all times contaminated, but that traces of pollution can sometimes be found after the sewage has been thoroughly commingled with the waters of the bay and has traveled miles from its point of origin. The commission does not desire, however, to base too great importance on these analyses. Such analyses are rather indicative of lines of investigation than conclusive in themselves.

Concerning other industries likely to be affected by serious pollution of the waters, it should be noted that excursion steamers car-

ried in 1903 nearly 2,500,000 passengers to bathing beaches
20 and day summer resorts, on or near New York bay, where have been invested a number of million dollars which would be jeopardized by serious pollution of the adjoining waters. The ferries carries during 1903 something over 200,000,000 passengers of whom nearly 9,000,000 crossed the centre of the Upper bay. These passengers are entitled to have their trip kept free from an offensive condition of the harbor waters which will unquestionably develop in time, if the present rate of increase in sewage flow continues and should be added to by the full proposed discharge from the Passaic Valley trunk sewer. The nearest precedent to the construction of such a sewer as is proposed by the State of New Jersey, and the discharge of sewage at either one or several points near together is from the system of the city of Boston and metropolitan districts adjoining, where a discharge at Deer Island in Boston harbor of about 40,000,000 gallons of sewage per day causes the waters about the outlet to be discolored over an area of approximately three-quarters of a square mile. At Moon Island, in Boston harbor, a discharge of about 22,000,000 gallons of sewage in less than one hour coming from tidal detention basins discolors about one and one-quarter square miles, fully two-thirds of this area being offensive to both sight and smell. It seems possible that the sewage from the proposed outfall of the Passaic Valley trunk sewer would discolor and render more or less offensive, well towards five square miles of the most beautiful and most traveled part of New York bay, covering the water on calm days at least, with "sleek" or a thin film of grease, which might extend to Liberty, Ellis and Governors Islands and at times even as far as the Battery, Brooklyn and much of the north and easterly shores of Staten Island.

21 Legislative and Reported History of the New Jersey Project.

Chapter 7 of the Laws of 1896 of the State of New Jersey was entitled "An act for the consideration of the general system of sewage disposal for the valley of the Passaic river and prevention of the pollution thereof."

This law provided for the appointment by the Governor of three citizens of New Jersey to consider the general project. Ten thousand dollars were appropriated to defray the expenses of their investigations.

The report of the commission subsequently appointed by Governor Griggs was submitted to the Legislature Feb. 26, 1897, and included the individual reports of the engineer, chemist, bacteriologist, and secretary, with conclusions and recommendations, including the draft of "An act providing for the purification of the rivers and streams of water within this State (New Jersey) and prevent the pollution of the same."

The Legislature on March 24, 1897, passed an act, becoming chapter 35 of the Laws of 1897, to prevent the wilful pollution of the Passaic river and the tributaries thereof, above the Great Falls of the

Passaic River at Paterson; said act being evidently intended rather to protect the purity of the water supply controlled by the East Jersey Water Company than to reduce the pollution in the lower Passaic Valley.

The report of the commission of 1896 above referred to, did not result in the passage of the law desired, but did result in the passage of an act authorizing a committee of members of the Legislature to study the subject and report at the next session. Various public hearings were held, and in the spring of 1898 the committee
22 reported as a result of its labors that the whole matter ought to be again studied by a new commission, which commission was duly appointed by Governor Vorhees.

The Legislature of 1899 again took up the matter and passed a bill, forming chapter 210 of the Laws of 1899, entitled, "An act to prevent the pollution of the waters in this State (New Jersey) by the establishment of a State Sewerage Commission, authorizing the creation of sewerage districts and district sewerage boards and prescribing and regulating the duties and powers of such commission and such boards." The sum of $5,000 was appropriated for expenses. It may be noted that the functions of this State sewerage commission are general and are not confined to the Passaic Valley solely. This commission has filed several annual reports, viz., for the years 1899, 1900, 1901, and 1902. As a result of their recommendation a law was passed giving additional powers to the commission, by which it could compel the abatement of existing nuisances of certain classes, and authorizing two or more municipalities to cooperate in providing for sewer systems and sewage disposal plants.

In 1900 the Legislature amended the original law, establishing the State Commission, reenacting it as chapter 72 of the Laws of 1900, giving rather broader powers. In 1902 the Legislature passed an act (chapter 48 of the Laws of 1902) establishing a separate sewerage district for the Passaic Valley, and creating a special commission therefor. The State commission since then has been enabled to devote its energies to other localities. The same Legislature also passed an act, becoming chapter 49, providing for the creation and incorporation of sewerage and drainage districts, for each of which the Governor could appoint a commission of five residents of such sewerage district.

23 Under the two laws just referred to, the "Passaic Valley Sewerage District" was created and a commission of five members appointed. This commission organized April 22, 1902, and selected a chief engineer. It submitted its first report to the Legislature on January 23, 1903, containing the report of its chief engineer and a draft of a proposed bill which would more thoroughly provide for carrying out the improvements recommended than possible under existing laws. The studies included two alternative general plans: First, a system of intercepting sewers extending from Paterson to Newark bay, by which the sewage of the valley would be brought to and discharged into the waters of upper New York bay without preliminary purification; second, a similar system of intercepting sewers, but in place of crude disposal, to construct one

or more purification plants where the sewage would first be treated and the purified effluent discharged into the Passaic river or Newark bay. The former plan was recommended by the chief engineer, and is the plan adopted by the Passaic Valley District Sewerage Commission for execution.

It comprises a main interceptor extending from a point near the Great Falls of the Passaic, in the city of Paterson, along the right or westerly bank of the Passaic river to a point in the city of Newark, where it leaves the river and passes southeasterly through the city, across the salt meadows to a point on the shore of Newark bay, about opposite West Bergen Point, where a main pumping station is to be located. From the pumping station the sewage is to be forced through two steel force mains (six feet each in diameter) under Newark bay and up into a gravity sewer thirteen feet in diameter, leading southeasterly along the Morris and Essex canal to a point jutting out into upper New York bay near Pamrapo; from
24 whence the sewage would pass through an eight foot steel pipe leading under New York bay, to a point about three-quarters of a mile northeast of Robbins reef light and opening out in a depth of water of about forty feet below mean low tide.

The Legislature of 1903 passed an act on April 22, modifying somewhat the provisions of the law, to effect, that before any work should be undertaken or obligations incurred, the Passaic Valley Sewerage Commission should investigate whether the proposed discharge of sewage into New York bay is likely to pollute the waters of said bay to such an extent or to such a degree as to create a nuisance to persons or property within the State of New York; and that no work should be carried out until after such investigation had been made and report presented thereon, and until the Attorney-General should in writing advise that no cause of action, either for damage or injunction, would arise in favor of the State of New York or any of its inhabitants by reason of said proposed discharge of sewage.

On June 8, 1903, such special report was submitted giving the opinion of the commission that such discharge of sewage would not pollute the waters of New York bay to such an extent or to such a degree as to cause a nuisance to persons or property within the State of New York; the conclusions of the commission being largely based upon written opinions received from a number of well-known engineers. Governor Murphy having examined the special report, referred it to the State Attorney-General for legal opinion, who advised that in his opinion there would be no legal objection from the authorities of New York. The Governor thereupon authorized the sewer commission to proceed to the construction of the improvements contemplated, and the Supreme Court upon certiorari proceedings upheld the constitutionality of the act. Prior to the report
25 above mentioned the Legislature of the State of New York authorized the appointment of the New York Bay Pollution Commission, which is now filing its report, objections and recommendations.

On March 6, 1905, the Court of Errors and Appeals of the State

of New Jersey declared unconstitutional the act of 1903, under which the Passaic Valley District Sewerage Commission proposed to construct its great trunk system and empty the sewage into New York bay; ten judges being in favor of reversing the Supreme Court which had declared the act constitutional, and but one judge upholding said court. The fatal defect was held to be the method provided for levying taxes to meet the cost of construction and maintenance. Consequently, the immediate threatened danger from the special sewerage system, which caused the appointment of this commission, is delayed by this decision of the New Jersey judiciary. Undoubtedly, however, there will be renewed attempts to pass an act which will avoid the defects of the former ones, so that New York State should continue to take cognizance of this question, and the greater one of general pollution of the harbor as well.

Possible Ocean Disposal of All Sewerage Wastes.

The waters of New York harbor and vicinity are invaluable to the inhabitants of the metropolitan district in their facilitation of New York's enormous commerce, the fact being well established that water communication is far more economical and convenient than land systems. In the relation of the waters to climatic and sanitary conditions the value is also beyond computation, in tempering both heat of the summer and the cold of the winter; and in carrying off or assimilating a large portion of the waste products of civilization which inevitably reach them even when sewers
26 can be made to carry a large part of the wastes to distant points. Probably over a million persons from the district cross these waters at many points daily in going between their homes and their places of business.

While a great deal has been done in the way of caring for urban waste in the final disposal of garbage and purification of sewage, no practical steps have as yet been taken in the metropolitan district towards relieving the district entirely from the sewage being poured into the waters of the harbor by the hundreds of millions of gallons daily. The only consideration that has been given as a rule, has been to conduct the sewage by the cheapest possible route and means to tidal waters, practically regardless of the effect upon them. But two real systems of ultimate final disposal are open to the district as a whole,—one, improved sewage disposal plants for each local district or municipality, established within its own boundaries, which plants would so treat the sewage as to make the effluent innocuous and inoffensive when it reaches the waters of the harbor, the solids being removed or destroyed; the other, the carrying out of some comprehensive scheme for ocean disposal of the crude sewage from the whole metropolitan district lying in New York and New Jersey either by one or by several great trunk sewers or tunnels.

A work of such magnitude can only be suggested at this time in the barest outline, as studies and plans would need to be exceedingly exhaustive and in great detail in order to properly conserve the sanitary and financial interests of the districts affected.

In general the conclusions of the commission would seem to be that owing to the nature of the development of New York city
27 and its environs, the first plan of separate utilization plans would be practically impossible of execution. Therefore, the other plan of ultimate ocean disposal seems to offer the most promising possible solution of the whole question, and one worthy of the fullest and most thorough investigation and development.

Needs of the Whole District and Desirability of Joint State Action.

The commission, from the very inception of its investigations, has been confronted with the fact that the construction of the proposed Passaic Valley sewer is only one of many similar problems demanding legislative action for the protection of the waters of New York bay sewage contamination.

The contention of the New Jersey commission that because the bay is now more or less directly receiving raw sewage from 4,000,000 people, therefore an increase from 1,000,000 more should be permitted is untenable.

The harbor is now an immense cesspool, which like smaller receptacles of sewage, has a natural limit of capacity, beyond which lies the danger to the health and comfort of the contiguous metropolitan district. The residents of New Jersey, who thus expected to discharge their waste through the proposed sewer, are equally interested with the inhabitants of New York city in preserving the waters of the harbor from further contamination.

The establishment of a metropolitan sewerage district has been suggested, to include all sections in both New York State and New Jersey which now or in future might sewer into the bay and its tributaries. Such a district, when authorized by joint State and federal legislation, should be under the direction and control of a permanent interstate commission, with plenary power to
28 control the discharge of all sewers hereafter constructed, as well as the evolving of a comprehensive plan for ultimately rendering the present chaotic and systemless method of sewage disposal, sanitary and suitable for all future requirements.

The necessity already exists for a central authority to not only direct, but also initiate such great public works, upon which depend the beauty and healthfulness of the approximately 450 miles of shore within the metropolitan district.

Legal Status of New York's Jurisdiction Over the Harbor Waters.

Certain questions were presented to State Attorney-General Cunneen from whose replies, abstracts are herein presented (the full answers in Appendix 6).

1. What is the status of the waters of New York harbor as to control over pollution, by the Federal Government and by the two States of New York and New Jersey?

Answer. In the year 1833 an agreement was entered into between these two States, subsequently ratified by their Legislatures and

approved by Congress, which established the common boundary line and which conceded to New York the exclusive jurisdiction of, and over, all waters of the bay of New York, and of, and over, all the waters of the Hudson river lying west of Manhattan Island and southward from Spuyten Duyvil creek, to low water mark on the westerly or New Jersey side thereof, subject to rights of property and of jurisdiction over the same by the State of New Jersey, from the joint boundary line westward and northward respectively; except that vessels even tied to New Jersey docks should be subject to the quarantine or health laws and laws in relation to passengers in the State of New York as they then existed or that might thereafter be passed. The right of regulating fisheries to the westward of the joint boundary line was reserved to the State of New Jersey.

The New York Court of Appeals in one of its decisions deduced a rule which indicated that New York had the right under the agreement to enforce quarantine and sanitary laws over all the waters of New York harbor as described, though both States could retain their absolute control over land under water and docks, vessels or other floating craft attached to any wharf or pier, as far as property rights were concerned; or violation of laws other than those offences against New York quarantine or health laws.

2. Whether the Federal Government would have jurisdiction over any phase of construction and operation of a large proposed trunk sewer to empty into the waters of New York harbor?

Answer. Federal jurisdiction is concerned specially with interference with navigation; consequently if the Passaic Valley trunk sewer should be so constructed as to interfere with navigation, or should its construction and operation be likely to so interfere, the Federal Government would undoubtedly have the right to interpose objection through an action brought in the Supreme Court of the United States. Such action was unchallenged by the State of Missouri against the State of Illinois and the sanitary district of Chicago, concerning the construction and operation of the Chicago drainage canal which proposed to carry sewage from the city of Chicago through a canal and the Illinois river to the Mississippi river. The bill in the action was demurred to, but the court sustained the right of the State of Missouri to maintain its proceedings, based on the sanitary features of the case. Consequently the Federal Government, as represented by the Supreme Court of the United States, would seem to have jurisdiction, not alone on the score of interference with navigation, but to recognize an action brought by the State of New York, in said court, to compel the State of New Jersey and the Passaic Valley District Sewerage Commission to refrain from polluting the waters of New York harbor with so great a mass of sewage as that contemplated, on sanitary grounds.

3. What power, if any, has the State of New York to impose conditions upon the State of New Jersey as to constructing the proposed sewer and to operating it in future?

Answer. The State of New York could only force action or non-

action by the State of New Jersey by proceedings brought before the Supreme Court of the United States.

4. Whether the New York Bay Pollution Commission is authorized by law to suggest detailed plans for any changes in construction of the New Jersey sewer if same is to discharge into the waters of New York bay, and objection be made to the present plans as formulated by the New Jersey Commission?

Answer. There seems to be no objection to the New York Commission making suggestions and recommendations to the New Jersey Commission, though such suggestions could not be enforced.

5. Whether in the event this commission finds it desirable to recommend for future consideration the establishment of a metropolitan district covering parts of the two States of New York and New Jersey, the Legislatures of the two States have authority to establish such district and appoint a commission having adequate powers of administration?

Answer. The legislatures of the two States could undoubtedly establish in each State respectively, a certain district to
31 adjoin a similar district in the other state, and give jurisdiction thereover, to the courts of one or the other of said two States as to all matters pertaining to the sewerage of said district; but it would seem desirable that such possible concurrent acts of the Legislatures of the States of New York and New Jersey should be first approved and ratified by an act of Congress.

Conclusions and Recommendations.

Based upon the commission's own researches during the past eighteen months, and judging from the experiences of other localities, so far as conditions are similar, together with reports along allied lines by other investigators, the New York Bay Pollution Commission concludes as follows:

1. It unhesitatingly protests against the consummation of the present plan of construction as outlined by the Passaic Valley District Sewerage Commission.

2. It recommends that the Legislature authorize the Governor of the State of New York to appoint a Metropolitan District Sewerage Commission. This commission should continue similar examinations to those conducted by the New York Bay Pollution Commission and should thoroughly investigate the questions from engineering and economic standpoints, and make preliminary surveys for, and estimates of cost of, a comprehensive system, for ocean disposal of the sewage of the whole or the greater portion of the districts in both New York and New Jersey which are naturally tributary to New York Bay and adjacent waters. Such act of authorization should include a request that the State of New Jersey appoint a similar commission to work conjointly with that representing New York; the two commissions to cooperate in the investigations and
32 recommendations as to a comprehensive scheme of ocean disposal for the district and to outline a course of procedure for later authoritative action by the two States respectively

and the Congress of the United States. This commission ought to be provided with adequate funds for examinations, surveys, analyses, plans, etc.,—form for such bill presented herewith as Appendix 8.

In the event of the State of New Jersey pressing the construction of the proposed Passaic Valley sewer as planned, if such be authorized by constitutional legislation, the commission would recommend:

3. That the Attorney-General of the State of New York be authorized and directed to bring an action in the Supreme Court of the United States against the State of New Jersey and the Passaic Valley District Sewerage Commission, upon his attention being called to any act of said State of New Jersey, or said sewerage commission, towards carrying into effect the construction of said proposed sewerage system.

In closing, the New York Bay Pollution Commission wishes to express its thanks to the many (Appendix 11) who have been of assistance to it in freely giving of their time and data, and to the few whom the commission has retained for special services, which have been rendered in fuller measure than the direct recompense alone could have required.

Respectfully submitted,

DANIEL LEWIS, *Chairman;*
OLIN H. LANDRETH,
GEORGE A. SOPER,
MYRON S. FALK,
LOUIS L. TRIBUS, *Secretary,*
Commissioners.

March 31, 1905.

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APPENDIX 1.

Tidal and River Flow.

By Commissioner Myron S. Falk.

It is impossible to obtain exact figures concerning the tidal flow phenomena of the lower Hudson river and New York Bay, but it is probable that a quantity of water not far from twelve to thirteen billion cubic feet enters the upper bay with each tide. Of this quantity, the relative proportions may be taken as follows:

4,250 million cubic feet passing into the East river.
6,750 million cubic feet passing up the Hudson river.
1,750 million cubic feet passing into Kill von Kull.

12,750 million cubic feet total.

These figures are of interest when taken in connection with the areas of the various tidal basins. The tidal area of the Passaic and Hackensack rivers, Newark bay and Kill von Kull comprises about

14.2 square miles. The tidal area of the upper bay is 21.6 square miles, and that of the East River 4.5 square miles; that of the Hudson river can be estimated only with difficulty as the tidal action is noticed at different periods of the year nearly all of the way to Albany.

Path of the Ebb Tide.

The ebb tide coming down the Hudson meets the ebb tide coming eastward out of the Kill von Kull, and both reach in and strike Staten Island between Stapleton and Clifton at a point dis-
34 tant about three to four miles from Robbins Reef light. The tide, then, makes along the shore and traveling along the beach makes Fort Wadesworth. At the same time there is also an ebb coming from the Arthur Kill and Raritan river which, striking the main tide from the Narrows tends to throw it to the eastward again. In calm weather the force of the main tide through the Narrows may reach as far as Swinburne Island and Orchard Shoal, although all winds tend to deflect the current.

Path of the Flood Tide.

The first effect of the flood tide through the Narrows is to strike the shore of Staten Island a little north of the point where the first effect of the ebb is felt; the second effect of the flood is to strike into the flats of the upper bay and to the west of Robbins Reef; the third, is to flow into the Kill von Kull; and the fourth and final effect is to flow up the Hudson river. After the first action of the flood is felt, the tide also travels up on the Brooklyn side of the bay. It is probable that in calm weather the maximum effect of the flood tide is felt on the northwest side of the bay.

General Facts.

The tidal ebb is detected five or six miles from the outer face of the bar, sometimes even outside of Sandy Hook lightship, but there rarely seems to be any concentration of its effects. As gathered from the Government reports, the maximum ebb velocity of the current at the Narrows is 1.5 knots, and the maximum flood 1.2 knots. In the Hudson off Thirty-ninth street these figures are respectively 2.7 and 2.0 knots, and in the East river off Twenty-third street 2.0 and 1.8 knots. Estimating a constant velocity of discharge
35 during the various tidal periods of the day the average ebb velocity at the Narrows would reduce to 1.61 miles per hour; the average flood velocity to 1.48 miles per hour.

The following figures furnish data upon which may be based the computations for determining the dilution of sewage emptying into New York bay or its vicinity; they are taken from the Report of the United States Coast and Geodetic survey for 1886, (page 36):

TABLE I.

Epitome of Results for Discharge.

June 25, 1886.

	Cubic feet.
East river (Nineteenth street):	
Ebb (westerly)	4,454,937,257
Flood (easterly)	4,007,175,676
Excess of ebb	447,761,581
Hudson river (Thirty-ninth street):	
Ebb (southerly)	6,996,678,413
Flood (northerly	6,225,985,545
Excess of ebb	770,692,868
Kill von Kull (West New Brighton):	
Ebb (toward the harbor)	1,790,103,372
Flood	1,712,415,362
Excess of ebb	77,688,010
Narrows:	
Ebb (seaward)	13,819,895,144
Flood	12,703,616,481
Excess of ebb	1,116,278,663

86 It would seem that a verification of the above results might be obtained by finding the sum of the products obtained by multiplying the area of each tidal basin, by the mean rise of the tide in said basin; the following figures furnish such a check. The computations were made in 1884, and have been taken from papers on file in the office of Col. Chas. R. Suter, Corps of Engineers, Army Building, New York City.

TABLE II.

	Tidal area in square feet.	Tidal area in square miles.	Mean range of tide in feet.	Tidal prism in cubic feet.
Upper Bay	601,824,505	21.6	4.4	2,888,757,624
Kill von Kull	68,072,219	2.4	4.6	313,132,206
Newark Bay	235,484,775	8.5	4.8	1,130,326,920
Passaic River	26,446,126	0.95	4.6	121,652,179
Hackensack River	66,765,580	2.4	4.8	320,474,786
East River (to Hell Gate)	126,309,810	4.5	4.4	555,763,164
Total				5,330,106,879

It is proper to note that in this table the northern boundary of the Upper bay is given by a line drawn from the most southerly point of New York City across the mouths of the Hudson and East rivers to the nearest point of land on the opposite shores; the western boundary by a line drawn from Constables Point across the Kill von Kull to the nearest point of Staten Island shore, and the southern boundary by a line drawn across the Narrows, from Ft. Tompkins light to the nearest point of Staten Island shore. It is not stated, from the papers on file, whether these areas are measured to the bulkhead lines or pier head lines of that time; this will cause no material error, however, even if these lines should have suffered change.

There must also be added to the total amount of tidal prism of Table II, the tidal prism of the Hudson river. The tidal area of the Hudson river, from its mouth to Poughkeepsie, comprises 2,-518,740,000 square feet; from its mouth to the State Dam at
37 Albany 3,789,820,000 square feet; but since the average tidal rise is rather difficult to obtain, as the Hudson is occupied by two tides at one time in different portions of its length, the following figures are believed to furnish sufficiently accurate results.

From the Coast Survey Report of 1858 (page 118), the discharge at the

Close of wet season (June 1)	6,038,000,000 cu. feet.
Close of dry season (September)	3,360,000,000 cu. feet.
Mean	4,699,000,000 cu. feet.

From observations from the same source in October, 1872, the flow (found nearly equal for "in" or "out" flow) was found to be 4,511,000,000 cubic feet and from Table I, above quoted, the ebb flow was found to be 6,997,000,000 cubic feet, and the flood 6,226,-000,000 cubic feet. An average of 5,000,000,000 cubic feet is probably correct and would correspond to an average rise of the tide between New York and Poughkeepsie of about 2 feet.

By adding these 5,000,000,000 cubic feet to the total of Table II, a reasonable check is furnished to the figures of Table I (assuming in Table II no entry of water into Newark bay, etc., by way of the kills).

It seems proper, then, to estimate the quantity of water which enters the bay with each tide at between 12 to 13,000,000,000 cubic feet. How much of this is available for the dilution of the sewage to be emptied into the bay at one point by the State of New Jersey, is questionable.

The following figures relating to the fresh water discharge of the Hudson river, were found in Col. Suter's office; they are believed to have considerable value:

Area drained into lower New York bay..... 16.335 square miles
Average rain fall per year at Albany..... 38.73 inches

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Average rain fall per year at Ft. Hamilton... 39.57
Average rain fall per year at Ft. Columbus... 43.32 } 41.923 inches
Average rain fall per year at New York city... 42.88

Area affected by Albany gauge..... 11,410 square miles
Area affected by mean New York gauge..... 4,925 square miles

Rain fall per second, Albany area..... 32,555 cubic feet
Rain fall per second, New York area..... 15,210 cubic feet

Total Albany and New York areas..... 47,765 cubic feet

Assuming five-tenths of this drained into lower New York bay, furnishes 23,883 cubic feet per second, or, 1,031,745,600 per twelve hours. Any other ratio than five-tenths, could easily be used.

The following data, relating to the timing of currents, has been taken from Bulletin No. 8, Second Edition, U. S. Coast and Geodetic Survey.

Currents—New York Bay and Harbor.

Subject.	Location. Narrows.
Time of high-water slack after high-water at Sandy Hook	Hr. Min. 2 00
Duration of slack	Min. 15 to 30
Time of maximum ebb after high-water at Sandy Hook	Hr. Min. 4 30
Maximum ebb velocity	Knots. 1.5
Time of low-water slack after low-water at Sandy Hook	Hr. Min. 2 30
Duration of slack	Min. 15 to 30
Time of maximum flood after low-water at Sandy Hook	Hr. Min 5 12
Maximum flood velocity	Knots. 1.2

Remark.

In the Narrows both the ebb and flood currents appear first on the east side.

Subject.	Location. Hudson River off 39th street.	East River off 23d street.	East River off Old Ferry Point.
Time of high-water slack after high-water at Governors Island	Hr. Min. 3 08	Hr. Min. 1 54	Hr. Min. 1 16
Duration of slack	Min. 40 to 55	Min. 4 to 8	Min. 20
Time of maximum ebb after high-water at Governors Island	Hr. Min. 6 17	Hr. Min. 4 30	Hr. Min. 4 14
Maximum ebb velocity	Knots. 2.7	Knots. 2.0	Knots. 1.4
Time of low-water slack after low-water at Governors Island	Hr. Min. 3 03	Hr. Min 1 37	Hr. Min. 1 02
Duration of slack	Min. 35	Min. 4 to 8	Min. 18
Time of maximum flood after low-water at Governors Island	Hr. Min. 5 43	Hr. Min. 4 24	Hr. Min. 2 42
Maximum flood velocity	Knots. 2.0	Knots. 1.8	Knots. 1.6

Remark.

In the path of the Hudson, from the Narrows to the Tappan Sea, it is running flood 15 feet below the surface fully an hour before the turning from ebb to flood at the surface.

39 The following table, relating to direction and velocity of currents in New York bay and harbor, has been taken from Bulletin No. 3, (1888) U. S. Coast and Geodetic Survey, page 8.

Lunar hour.	Sandy Hook Bar.	The Narrows.	Kill von Kull.	Hudson River, 42d street.	East River, 10th street.	East River, Old Ferry Point.
	Feet per second.	Feet per second.	Feet per second.	Feet per second	Feet per second	Feet per second
O	S. 3.50	S. 3.20	E. 2.00	S. 2.09	S. 4.14	W. 1.25
I	S. 2.35	S. 2.75	E. 1.74	S. 4.84	S. 4.36	W. 0.90 Surface. E. 0.95 Bottom.
II	S. 2.16	S. 2.50	E. 1.53	S. 5.10	S. 2.64	W. 0.85
III	N. 0.30	Surface. S. 2.38 Bottom. N. 1.01	W. 0.61	S. 4.09	S. 1.80	E. 1.45
IV	N. 2.08	Surface. S. 1.55 Bottom. N. 1.20	W. 1.90	Surface. S. 2.50 Bottom. N. 1.08	N. 2.98	E. 1.75
V	N. 2.54	N. 1.00	W. 3.07	Surface. S. 0.91 Bottom. N. 1.91	N. 3.73	E. 1.95
VI	N. 2.53	N. 2.20	W. 2.45	N. 2.25	N. 3.88	E. 2.20
VII	N. 2.50	N. 2.20	W. 2.11	N. 3.67	N. 3.67	E. 2.05
VIII	S. 2.00	N. 2.10	Surface. E. 0.82 Bottom. W. 0.10	N. 3.17	N. 2.90	E. 1.10
IX	S. 1.98	N. 0.88	E. 1.71	N. 2.33	N. 1.69	W. 1.07
X	S. 2.33	S. 0.81	E. 2.32	N. 1.08	S. 3.60	W. 1.00
XI	S. 3.48	S. 2.10	E. 2.16	Surface. S. 0.74 Bottom. N. 0.65	S. 3.70	W. 2.00

E. signifies East.
W. signifies West.
N. signifies North.
S. signifies South.

Currents.

To determine exactly the motion of the water in the bay, it would be necessary to measure velocities of flow, not only at sections separated by horizontal distances, but also at sections separated by vertical distances; furthermore, such observations would be necessary for every single stage of the tide, both ebb and flood. As far as the writer knows, complete investigations of this kind have never been made, although the U. S. Coast and Geodetic Survey reports* contain tables showing velocities measured either along horizontal or vertical lines,
40 but not along both at the same time. Of these measurements, moreover, none is later than 1888, and various building operations occurring since that time, such as the cutting through of the Harlem ship canal, building of piers, etc., would probably render those results of comparatively little value. It seems, therefore, ad-

* See Appendix 8, report for 1871.
See Appendix 10, report for 1876.
See Appendix 15, report for 1887.

visable, except for the preceding general tables, to appeal to the personal opinions of men familiar with those matters.

The general average velocity of the currents is easily obtained; it is necessary only to divide the ebb or flood flow by the cross-section of the corresponding channel. For instance, the area of cross-section at the Narrows is 271,480 square feet; the average ebb velocity, using the figures of Table I, would then be 1.61 miles per hour, assuming that the ebb discharge for six hours would be constant; similarly, the flood velocity would average 1.48 miles per hour. Since there are times of no velocity, it is evident that the maximum velocities will at times greatly exceed these average velocities.

The cross-section of the Harlem river at Thirty-ninth street, contains approximately 173,000 square feet; the average ebb velocity would then be 1.26 miles per hour, and the flood velocity 1.13 miles per hour.

One matter of considerable importance is the question of the under-run of the salt water below the fresh water of the Hudson. The difference in specific gravity between these two waters may be as high as 2½%, and there is thus an obvious tendency for the salt water to force itself up the river for a considerable distance and to remain stagnant while fresh water follows its way down to the sea.

This tendency is probably more marked at times of low
41 water in the river. It seems proper to consider, then, whether the sewage which is discharged into the salt water may not, at various portions of the year, be stored in the pot-holes and basins of the river.

42 ## Appendix 2.

Present Sewage Pollution in New York Harbor.

By Commissioner Louis L. Tribus.

Having been assigned to the investigation of the present sources of pollution of New York harbor, I would report as follows:

I have consulted with the officials having knowledge concerning, or direct charge of, the sewerage system in each of the boroughs of the city of New York, and each of the municipalities adjoining New York Harbor and its estuaries, from the north side of Yonkers, southward, and have secured from them much of the available information as to the situation of sewers and the estimated outflow therefrom.

Whereas the great majority of sewers emptying into these waters carry both sanitary and storm flow, it may be considered that sanitary or dry weather discharge alone particularly requires our consideration, for its peculiarly polluting influence on the waters of the harbor. While at times of storm there is a great washing into the harbor of street refuse, the dilution is at once so great from the storm flow itself and in general the storms are so infrequent that we scarcely need to consider this amount of material, though

exceedingly filthy in itself, as being a serious menace to health or likely to create a permanent nuisance.

The suspended matters in the sanitary flow alone, however, if weighed dry, probably nearly equal 1,000 tons daily, surely a quantity worth anxious thought.

43 The whole territory for a radius of twenty miles from New York City Hall may be called the New York Metropolitan District, as the interests of practically all portions within that district are nearly identical, the manufacturing establishments, stores, offices and homes of those whose interests center in New York city; consequently, I would use the city's name as indicating the whole district noted, even though many municipalities be included and in two different states.

It may not be generally appreciated that this district is one of the largest manufacturing communities of the world and with variety of products almost beyond enumeration, so that the wastes carried through the sewers are equally diverse in character. It should be noted that practically all wastes other than garbage, rubbish and ashes reach the sewers, being carried thereto and therein by an abundant flow of water. While water in itself is a cleansing element, it is so much more convenient a method for the disposal of wastes than others, that the percentage of wastes is actually increased by its use.

Leaving out of consideration the storm water flow, there remains for the constant daily source of sewage pollution, the water borne house and factory wastes; consequently, the quantity of water used in the community is probably the safest estimate and, in fact, the only estimate which can well be presented, to indicate the amount of daily sewage.

The following table has been prepared showing the communities along the shores of New York harbor, the particular body of water into which their sewers empty, the respective estimated populations as of the year 1904, and the estimated daily discharge of sewage in million gallons, based on water consumption. The sewer outlet outlet numbers refer to numbers which will be found upon the map accompanying the main report of this commission.

44 *Approximate Daily Sanitary Sewage Discharge Into New York Harbor.*

Community.	Discharging into—	Sewer outlets. Numbers on map.	Estimated population.	Sanitary flow in million gallons per 24 hours.
Yonkers	Hudson River	330 to 341	56,000	6
New York (Manhattan)	Hudson River	1 to 53	823,000	82
New York (Manhattan)	Harlem and East Rivers	54 to 158	1,234,000	124
New York (The Bronx)	Harlem and East Rivers	197 to 212	297,000	30
New York (Queens)	East River	213 to 236	147,000	15
New York (Queens)	Jamaica Bay	Not numbered	53,000	5
New York (Brooklyn)	East River	159 to 183	920,000	92
New York (Brooklyn)	Upper Bay	184 to 189	271,000	27
New York (Brooklyn)	Lower Bay	190 to 193	40,000	4
New York (Brooklyn)	Jamaica Bay	194 to 196	122,000	12
New York (Richmond)	Kill von Kull	242 to 260	35,000	4
New York (Richmond)	Upper Bay	261 to 278	20,000	2
New York (Richmond)	Lower Bay	Not numbered	8,000	1
New York (Richmond)	Arthur Kill	239 to 241	12,000	1
W. New York, Weehawken, Union, West Hoboken, Hoboken, Jersey City	Hudson River	279 to 305	334,000	33
Jersey City	Upper Bay	306 to 308	23,000	2
Bayonne	Upper Bay	309 to 311	15,000	1
Bayonne	Kill von Kull	312 to 315	27,000	3
Elizabeth and S. Orange system	Arthur Kill	342 to 347	91,000	9
Perth Amboy	Arthur Kill	316 to 329	22,000	2
Totals			4,550,000	455

In the report of the Passaic Valley District Sewerage Commission as presented to the New Jersey Legislature at its session in 1903, it is stated that the plan of the commission contemplates the ultimate construction of a sewer system which would pour into New York harbor nearly 350,000,000 gallons of sewage per twenty-hour hours, though it is not contemplated to execute the whole plant at present. The population to be provided for is estimated at from over 500,000 now to 1,600,000 ultimately. Taking the estimated proportions of the total sewage to total population, the plan would contemplate a debouchement, as soon as the sewer system could be constructed, of upwards of 100,000,000 gallons per twenty-hour hours.

Another large New Jersey sewerage district, though fortunately not so densely populated, is already draining into Kill von Kull at Elizabeth, taking the watershed to the west and southwest of the Passaic Valley district, and sewering a portion of Eliza-
45 beth, Irvington, Vailsburg, South Orange and West Orange. The estimated flow is, however, comparatively small, being from 5,000,000 to 8,000,000 gallons per twenty-four hours, based on dry weather conditions.

It may be noted that the plan of the Passaic Valley District Sewerage Commission, if carried out, would not introduce into the waters of New York a total flow more than would reach it by the ordinary

present routes, because all of the districts proposed to be relieved by said systems now sewer into adjacent streams which empty in turn into Newark bay, thence into Kill von Kull and Staten Island sound, from which the flow passes into respectively the upper and lower New York bays. The difference is, however, that at present, Newark bay, and to some extent the tributary streams, acts as a great settling basin, so that most of the heavier matters are deposited there and save the main harbor from the task of assimilating them. At present such use of Newark bay is not a very serious inconvenience to many interests, but the time can be readily foreseen when the nuisance there will be very evident and intolerable, but the main question at issue is one of conserving the interests of the greater number, rather than the few.

The cause for alarm in New York and vicinity arises from the proposal to empty this large quantity of sewage at approximately one point near the center of the main harbor. The harbor as a whole may be capable of assimilating a thousand million gallons of sewage per day, if distributed at five hundred scattered points, while the same harbor might not be able to assimilate one-tenth the quantity, if poured in at five points, and the nuisance would then become not merely local, but general, as the pool of raw sewage would travel to distant points carried by tide and wind.

46 Upon others of the commission devolves reporting on such of this question. I would, therefore, report in summary that the present direct daily sewage pollution of New York harbor and its estuaries from all existing sewers is taken to be 455,000,000 gallons from something over 4,500,000 population, with probably from 50,000,000 to 100,000,000 gallons more entering through Newark bay.

47 APPENDIX 3.

Sanitary and Bacteriological Examinations and Fisheries and Industries Affected by Pollution of New York Harbor.

By Commissioner George A. Soper.

The question as to the quality of the water and shellfish of the harbor was one which had to be studied largely by means of analyses, while that relating to the industries required the collection of statistical data and information from those who had moneyed interests connected with the bay.

No attempt was made to make the examination of the waters and shellfish exhaustive, although a comprehensive plan for determining the quality of the water in all parts of the bay and rivers in the neighborhood of New York would doubtless have produced results which would have been of much scientific interest. Owing to the small appropriation which was available for the analyses, only the simplest methods could be used and the number of analyses had to be kept as low as possible.

The value of this study of the quality of the water of the bay had been greatly increased by the fact that results of analyses which have been made for others, of the water of the Hudson river and certain other waters, have recently been published in official reports. Among these reports may be mentioned the report of the commission on an additional water supply for the city of New York, 1903; the report of the committee on the Charles river dam, Boston, 1903; the report of the Massachusetts State Board of Health upon the discharge of sewage into Boston harbor, 1900;
48 and the report of the Metropolitan Sewerage Commission upon a high level gravity sewer for the relief of the Charles and Neponset river valley, 1899. Some older documents relating to New York bay have also been useful, notably, Appendix 15, of the U. S. Coast and Geodetic Survey and a pamphlet issued by the Chamber of Commerce of the State of New York on the harbor of New York; its condition, May, 1873.

Accurate information concerning the industries which might be affected by pollution of the bay have been difficult to obtain, reliable statistics being lacking in some cases and estimates made by the Government, State and local authorities differing materially. Wherever it was not possible to reconcile the figures, the most conservative data have been adopted. Information of a statistical character relating to the industries of the bay has been courteously furnished by the U. S. Census Bureau, the U. S. Commission on Fish and Fisheries, the U. S. Steamboat Inspection Service, Bureau of Shell Fisheries of the Forest, Fish and Game Commission of New York State and by many private persons connected with the oyster and transportation business in the vicinity of New York. It is a pleasure to make acknowledgment here of the many favors received from these and other sources.

3—Present Chemical and Bacteriological Condition of the Harbor and Fisheries.

A—Bacterial Evidence of Pollution:—Water.

The bacterial analyses made by the commission, although not numerous, show that the water of the bay is polluted to an extent which, though not great, is at least measurable. About 50 samples of water were taken from the bay at many points between
49 the Battery and Coney Island on the one hand, and the Battery and Raritan bay on the other. These were analyzed with the result that the colon bacillus, an invariable accompaniment of sewage, was nearly always found according to the "presumptive" test.

For the purpose of the analyses, the water was collected in prepared and sterilized bottles by a person trained in such work. After filling, the bottles were immediately carried to the Mt. Prospect Laboratory, Brooklyn, and were examined, as a rule, within two hours of the time when they were collected. In the examinations for the bacillus coli communis, specimens of the water measuring

.1 cubic centimeter, 1 c. c. and 10 c. c. were taken from the bottles and mixed with fermentation broth in Smith tubes, substantially as indicated in the report of the State Board of Health of New York for 1892, p. 712. These tubes were then incubated at 37 deg. C., for 48 hours, or in case of negative results, longer. If colon bacilli were present, they would form gas which would then be analyzed. All of the laboratory work was done under the personal supervision of Mr. Daniel D. Jackson, sanitary chemist and biologist, except a few specimens which were shipped to the Bender Hygienic Laboratory, where they were examined under the supervision of Dr. R. M. Pearce, director.

Some of the samples of water which were sent to the laboratory in Brooklyn were examined for the number of bacteria of all kinds which they contained. The medium used for this bacterial work was nutrient gelatin, prepared according to the methods recommended by the laboratory section of the American Public
50 Health Association, and customarily employed by the analysts of the Department of Water, Gas and Electricity of the city of New York. All of this laboratory work was done in duplicate.

When the colon bacillus was believed to be present, the result of the examination was reported as plus, or simply +. When no evidence of this germ was found the result was reported as negative, or, for convenience, 0.

In interpreting the results, presumptive evidence of the presence of the colon bacillus in each of the three tubes, containing .1 c. c., 1 c. c. and 10 c. c. of water respectively, was taken to be evidence of pollution; no coli in .1 but a positive result with 1 and 10 was taken to mean probable evidence of pollution; coli in neither .1 nor 1, but a positive result with 10 was not regarded as sufficiently significant for any conclusion. These I regard as fairly conservative standards for use under the circumstances.

The following table shows the results which were obtained with the first series of samples taken.

Table 1. Results of examinations of the water of New York bay. The samples were collected along the route of the Iron Steamboat Company, from Pier 1, at the Battery, down the main ship channel of the Upper bay, through the Narrows to Coney Island. The samples were taken between 10 and 11 A. M., on the ebb tide, and between 4 and 5 P. M., on the flood tide. High water occurred at Governor's Island at 5:40 A. M. and 6:07 P. M. The winds were fresh, northeast to south, with a maximum velocity of 17 miles per hour. All of the samples were clear and practically odorless. The date was June 11, 1904.

51

Map No.	Point of collection.	Bacteria per c. c.		Tests for B. Coli.					
		Ebb tide.	Flood tide.	Ebb tide.			Flood tide.		
				0.1	1.0	10	0.1	1.0	10
1	North River at head of Pier 1	45,300	21,300	+	+	+	+	+	+
2	South of Liberty Island	28,000	15,600	0	+	+	+	+	+
3	Near Robbins Reef	24,500	16,300	0	0	+	0	+	+
4	Narrows	20,100	8,900	+	+	+	0	0	0
5	Off Gravesend Bay	27,900	12,900	0	+	+	+	+	+
6	South of Sea Gate	7,900	1,810	0	+	+	0	0	0
7	Iron Steamboat Co.'s Pierhead, Coney Island	6,200	1,900	+	+	+	0	+	+

This table shows that the number of bacteria diminished with some regularity from the Battery to Coney Island, excepting in the samples taken off Gravesend bay, where local sources of pollution exist. The tests for coli are less convincing, but indicate an improvement at the Narrows and at Sea Gate over the Upper bay. The fact that coli were more often found at Gravesend and Coney Island than in some places where their presence would be more expected suggests that local sources of contamination exist in these neighborhoods. On the whole the water of the incoming tide better than the water of the outgoing tide.

Analyses of harbor waters were continued in October with the object of learning something of the quality of the water along the Staten Island and Long Island shores and over the oyster beds which are situated along the west shore of the Lower bay. The results of these bacteriological examinations are given in the tables which follow:

Table 2. Results of examinations of water taken from various points between St. George and South Beach, Staten Island. The samples were collected from the ends of piers and docks along the shore, on October 17, 1904, between 12.25 and 3.40 P. M., toward the end of the flood tide, through slack water and the beginning of the ebb. The tide was high at Governor's Island at 2:47 P. M., and at the Narrows 25 minutes earlier. The wind was light, to fresh, 52 with a maximum velocity of 13 miles per hour; in direction, southwest and west.

Map No.	Point of collection.	Bacteria per c. c.	Tests for B. Coli.		
			0.1	1.0	10
8	St. George, end of east pier	28,400	+	+	+
9	Tompkinsville, end of south pier	14,000	0	+	+
10	Stapleton, Yacht Club dock	22,000	+	+	+
11	Between Stapleton and Clifton	12,800	0	+	+
12	Rosebank	9,300	0	0	+
13	Narrows above Fort Wadsworth (¾ mile)	5,440	+	+	+
14	East of Fort Wadsworth	5,250	0	+	+
15	South of Fort Wadsworth, (¾ mile)	6,500	+	+	+
16	South Beach, upper end	5,900	0	0	+
17	South Beach, middle	6,800	+	+	+

Table 2, when interpreted by the aid of other information, affords an instructive illustration of several matters which are of special importance in this investigation. The north side of Staten Island from the Narrows to St. George is provided with sewerage systems which discharge the sewage of 20,000 people into the waters of the Upper bay along this shore. When the samples of water were taken for examination, the current was running from east to west along the shore carrying an increasing load of sewage with it. This is admirably shown by the analyses, which indicate a decidedly polluted condition of the water of St. George and a progressive reduction in its impurities from this point to the vicinity of the Narrows. The nearest sewer outfall to the Narrows is near where sample 13 was taken, and beyond this point the number of bacteria and prevalence of coli are fairly uniform. The quality of water in the samples from 14 to 17, inclusive, is probably a fair indication of the quality of the water which occupied the Lower bay at the end of the flood tide.

Duplicates of samples 8, 9, 12 and 15 were sent to the Bender Hygienic Laboratory, for analysis. The results reported from this laboratory in connection with these and other samples have not always checked with the results reported by Mr. Jackson, the
53 disparity being accounted for on the assumption that the bacterial character of the waters changed during the three to six days which elapsed between the collection and analysis of the samples in the Bender Laboratory. The laboratory methods were not precisely alike. Instead of using fractional specimens of the water for examination, five Smith tubes were inoculated with 1 c. c. each at the Bender Laboratory. No germs of the coli type *was* found in any of them.

In order to investigate the quality of the water of Gravesend bay samples were collected in that part of the Lower bay on October 20, 1904. Previous analyses indicated that the water in this section was polluted, and as the bay is known to receive the sewage of about 40,000 people, and is used to some extent for the growing of clams and oysters, particular interest attached to the examinations. The results of the analyses are given in table 3.

Table 3. Results of examinations of water taken from various points between Fort Hamilton and Sea Gate, in Gravesend bay. The samples were collected from a boat along shore, October 20, 1904, between 1:45 P. M. and 3:45 P. M., through the middle of a rising tide. The tide was high at Sandy Hook at 4:52 P. M., and at the Narrows at 5:22 P. M. The wind was light to fresh, east to south, with a maximum velocity of 13 miles per hour.

Map No.	Point of collection.	Bacteria per c. c.	Tests for B. Coli. 0.1	1.0	10
18	Fort Hamilton, 100 feet south	6,480	+	+	+
19	Fort Hamilton Beach, 100 feet S. of W. end	3,360	0	0	0
20	Fort Hamilton Beach, 100 feet S. of E. end	3,180	0	0	+
21	Off Field and Marine Club, 20 feet from raft	2,900	+	+	+
22	100 feet off Avoca Villa pier	4,900	+	+	+
23	150 feet off beach below Captain's pier	7,500	+	+	+
24	100 feet off Pier of N. Y. Canoe Club	4,380	+	+	+
25	75 feet off Public Camp Ground	8,600	+	+	+
26	Opposite Coney Island, 300 feet from shore	5,700	0	0	0
27	Opposite Coney Island, half way across bay	8,800	+	+	+
28	North of Pier of Atlantic Yacht Club	8,500	0	+	+
29	Opposite Sea Gate, 200 feet north	8,200	0	0	+
30	Opposite Sea Gate, 500 feet north	8,900	0	0	+

Table 3 indicates that the water along practically the whole shore of Gravesend bay is polluted. More than half the examinations for coli resulted positively, even in samples of water as small as 0.1 of a cubic centimeter. The numbers of bacteria were smaller than would have been expected, in view of the known sources of pollution. The coli results for 20 can hardly represent the average condition of the water at the point named, for it is within but a few feet of a large sewer outfall. Altogether, the samples, although taken along the shore where the contamination ought to be greatest, do not show as much pollution as exists in Gravesend bay. The incoming tide was distinctly favorable to the purity of the samples. It is likely that Table 3 shows the best conditions which ordinarily occur.

In order to obtain a check on the analyses, duplicates of samples 19, 20, 21, 26, 29, and 30 were sent to the Bender Hygienic Laboratory at Albany. No evidence of coli was found in any sample except sample 20. In that case there were germs of the coli type found in one out of the five tubes inoculated.

A final series of samples for bacterial analysis was taken along the east shore of Staten Island on October 22, 1904. The series exhibited in Table 2 carried the observations to the Narrows, on the shore of Staten Island, and the series which is about to be described overlapped this somewhat and extended down the Lower bay to Tottenville, passing the day-summer resorts of Midland Beach and South Beach, and running over the extensive oyster beds which lie along this coast. The results of the examinations of the waters collected over this route are given in Table 4.

Table 4. Results of examinations of water taken from various points between Stapleton dock and a point off Tottenville, Staten Island, October 22, 1904. The samples were collected between 1:00 P. M. and 5:40 P. M. The tide was low at the Narrows at 12:25 and high at Sandy Hook at 6:17 P. M. The results were therefore obtained during a rising tide. There was a brisk west wind, with a maximum velocity of 30 miles per hour.

Map No.	Point of collection.	Bacteria per c. c.	Tests for B. Coli. 0.1	1.0	10
31	Stapleton Dock	7,690	0	0	0
32	Off Rosebank	6,980	0	+	+
33	Narrows, 100 feet off Fort Wadsworth	14,400	+	+	+
34	Between Hoffman Island and South Beach	6,780	+	+	+
35	Off Creek above Midland Beach	5,100	+	+	+
36	Off Elm Tree Beacon	2,300	0	0	0
37	Between Elm Tree Beacon and Great Kills	1,040	0	0	0
38	Great Kills Point	990	0	0	0
39	Great Kills	920	0	0	0
40	Great Kills, near shore	1,600	0	0	+
41	South of Great Kills	2,340	+	+	+
42	Off Latourette Point	2,620	+	+	+
43	Off Seguine's Point	1,650	0	+	+
44	Princess Bay	2,460	0	+	+
45	Lemon Creek at bridge	12,600	+	+	+
46	Lemon Creek, 500 feet above bridge	13,800	+	+	+
47	Off Red Bank, S. I.	2,560	0	0	+
48	Off Ward's Point	40,100	+	+	+
49	Between Ward's Point and Tottenville	51,300	+	+	+
50	Off Tottenville	59,700	+	+	+

A close study of Table 4, in connection with information concerning the territory over which the samples were taken, leads to the opinion that some of the results were influenced by local sources of pollution. Those at Lemon creek, Nos. 45 and 46, show the effects of drainage which enters that creek from about 2,010 acres of populated country tributary to it. Nos. 48 and 49 and 50 show pollution due to sewage from public sewer outfalls at Tottenville and perhaps more remote points above the Arthur Kill. The other 15 samples were not taken within close range of sewers, so far as is known, and therefore give a better knowledge of the effects of more distant contamination. Considered as a whole, the table may be divided into three parts. The samples from Rosebank to Midland Beach show marked evidence of pollution. From Elm Tree Beacon to beyond Great Kills the water contained but few bacteria and few
56 of the coli type. From south of Great Kills to Tottenville there was generally strong evidence of pollution.

A—Bacterial Evidence of Pollution.—Shellfish.

As will be more fully explained beyond, the cultivation of oysters and clams is carried on extensively in the waters of lower New York bay. Most of the shellfish are taken from the southeast shore of Staten Island, but some, and especially clams, are grown in that portion of the lower harbor known as Gravesend bay. To determine whether the oysters and clams grown in the bay bear any evidence of pollution, specimens of both kinds of shellfish have been collected and examined for bacteria of the coli type by means of the "presumptive" test.

The shellfish were collected by Mr. D. D. Jackson on the same trips on which he collected samples of water reported in Tables 3 and 4. They were collected by opening the shellfish with a sterilized knife and inoculating the liquid contained in the shell in por-

tions of 0.1 c. c., 1.0 c. c. and 10 c. c. in fermentation broth in Smith tubes. The laboratory process was thereafter similar to that followed in the examinations of water. All of the shellfish were taken fresh from the beds, except those from Lemon creek.

Table 5. Results of examinations for B. coli in fifty-one specimens of oysters and clams grown in the waters of lower New York bay.

Point of collection.	Date.	Number of shellfish examined.	Number of Positive Tests for Coli.		
			0.1 c. c.	1.0 c. c.	10 c. c.
Gravesend Bay, Sea Gate...	Oct. 20	6 clams.....	0	0	2
Gravesend Bay, Sea Gate....	Oct. 20	6 oysters.....	1	2	4
Gravesend Bay, Bath Beach..	Oct. 20	5 oysters.....	0	1	2
Off Elm Tree Beacon	Oct. 22	6 oysters.....	1	3	4
Swash Channel	Oct. 22	6 oysters.....	0	0	2
Great Kills	Oct. 22	10 oysters.....	0	0	1
Princes Bay	Oct. 22	6 oysters.....	0	1	2
Princes Bay, "drunk" in Lemon Creek	Oct. 22	6 oysters.....	3	5	6

For the sake of a check, six specimens of oysters from Bath Beach, Gravesend bay, and six from off Elm Tree Beacon were sent to the Bender Hygienic Laboratory, Albany. The oysters were there scrubbed with sterile salt solution and a sterile brush, after which the shell was opened with a sterile knife and the oyster and juice placed in a sterile dish. The meat was then finely divided and the supernatent milky fluid, in samples of 1 c. c. each, inoculated into 2 per cent. glucose broth in Smith tubes. The results of these tests for coli were positive in two of the six oysters from Gravesend bay and positive in five of the six oysters from off Elm Tree Beacon.

Table 5 demonstrates the very important fact that oysters which are grown in polluted water are usually themselves polluted. Yet the samples examined for this study did not always bear as much evidence of this pollution as might be expected. In view of the known pollution of Gravesend bay, a greater number of positive tests for coli might have been looked for there. The results may be explained by the fact that the shellfish in that bay are only cultivated in the least polluted localities. The oyster beds on the Staten Island shore seem to lie between two great sources of danger, one being the polluted water which passes out through the Narrows and the other being the contaminated water from the mouth of the Raritan river and the Arthur Kill. The oysters which were freest from coli came from the vicinity of the Great Kills and Swash channel—points which are well removed from local sources of pollution and apparently beyond the reach of contaminating matters from the cities. The oysters which were "drunk" in Lemon creek bear distinct evidence of the contamination of that creek.

58 B—Chemical Evidence of Pollution—Water.

The chemical analyses which have been made by ourselves and others show that the water bears chemical evidence of pollution both at ebb and flood tide, especially in the upper bay. The examinations do not warrant the opinion that the water is everywhere and at all times badly contaminated, but the chemical evidence well supports the bacterial results in showing that traces of pollution can be found after the sewage has been thoroughly commingled with the waters of the bay and traveled miles from its points of origin.

One of the best measures of pollution at the service of the chemist is the determination of nitrogen in the forms of free and albuminoid ammonia. The test for free ammonia is particularly significant for the reason that free ammonia is always present in sewage, and when found in large amounts in water, is not likely to have been derived from harmless sources.

The following figures showing the amounts of free and albuminoid ammonia which have been found in uncontaminated sea water, drinking water and sewage, are taken from a report of Mr. H. W. Clark, contained in the report of the Metropolitan Sewerage Commission upon a high level sewer for the relief of the Charles and Neponset River valleys, p. 91, a report by Mr. G. C. Whipple, contained in the report of the Commission on an Additional Water Supply for the City of New York, p. 520, and a report by Mr. H. W. Clark contained in the report of the Committee on the Charles River Dam, Boston, p. 221.

Table 6. Results of chemical analyses of sea water. (Parts per million.)

59

Point of collection of sample.	Date.	Free ammonia.	Albuminoid ammonia.	Chlorine.
Sea water	.....	.057	.124	
Quincy Bay, Massachusetts	.....	.056	.124	
Atlantic Ocean, 3 miles southeast of Sandy Hook lightship	Feb. 27, 1903	.064	.076	16.250
Off Boston lightship	Nov. 11, 1902	.012	.068	
Sewage	.....	45.4	7.5	
Good drinking water as high as	.....	.013	.16	
Hudson river at Poughkeepsie	.....	.020	.137	

Keeping these convenient standards in mind, we are prepared to examine the free and albuminoid ammonia in the water of New York bay, as shown by 14 chemical analyses.

Table 7. Results of chemical analyses of the water of New York bay. (Parts per million.)

Map No.	Point of collection of sample.	Tide.	Date.	Free ammonia.	Albuminoid ammonia.	Chlorine
1	Pier No. 1, North River.	Ebb...	June 11, 1904	.210	.100	6,550
4	Narrows	Ebb...	June 11, 1904	.120	.120	8,100
7	Coney Island	Ebb...	June 11, 1904	.170	.170	11,250
	Hudson River at 35th Street.....	Ebb...	Feb. 26, 1903	.168	.164	*7,200
	Battery	Ebb...	Feb. 26, 1903	.140	.152	*9,800
	Battery	Flood.	Feb. 27, 1903	.124	.180	*8,150
	Robbins Reef	Ebb...	Feb. 26, 1903	.144	.140	11,225
	Robbins Reef	Flood.	Feb. 27, 1903	.124	.260	11,225
	Narrows	Ebb...	Feb. 26, 1903	.132	.112	11,950
	Narrows	Flood.	Feb. 27, 1903	.144	.180	9,800
	Rockaway Bell Buoy...	Flood.	Feb. 27, 1903	.096	.088	14,850
	West Bank Light.....	Ebb...	Feb. 26, 1903	.128	.132	12,450
	Sandy Hook Light.....	Ebb...	Feb. 26, 1903	.052	.104	14,700
	Opposite Handy Hook Light	Flood.	Feb. 27, 1903	.072	.108	15,300
	Average			.129	.143	

*100 ft. off.
* "
* "

From this table it appears that the water of the bay contains about 2¾ as much free ammonia, and about 1½ times as much albuminoid ammonia, as pure sea water, and about 6½ times as much free ammonia, and about the same amount of albuminoid ammonia as the Hudson river at Poughkeepsie. Comparing this table with Table 6, it will be seen that the most polluted samples were taken from near the Battery, Robbins Reef, the Narrows and Coney Island. The figures in the last table, excepting those
60 relating to the first three samples, are taken from the report of the Commission on an Additional Water Supply for the City of New York. The same report contains data from which the following table has been made to show the ammonias in the water of the Hudson as far up as Kingston. The figures given are averages of weekly examinations made from February to August, 1903.

Table 8. Results of chemical analyses of water of the Hudson river. (Parts per million.)

Point of collection of sample.	Tide.	Free ammonia.	Albuminoid ammonia.
Newburgh	High...	.019	.126
Newburgh	Low....	.024	.140
Poughkeepsie	High...	.022	.126
Poughkeepsie	Low....	.019	.149
Hyde Park.....	High...	.024	.133
Hyde Park.....	Low....	.036	.153
Kingston	High...	.029	.131
Kingston	Low....	.029	.149
Average.....	.....	.025	.138

These figures show that the water of New York bay, as indicated in Table 7, contains nearly six times as much free ammonia and

about the same amount of albuminoid ammonia as the water of the Hudson between New York and Poughkeepsie.

B—The Effects of Tides, Currents and Other Purifying Agencies.

One of the suprising results of this investigation, as disclosed up to this point, is the fact that the tide has little visible effect in eliminating the evidences of pollution. It had always been assumed that the sewage and other organic impurities which drained into the harbor were carried away by the vast quantities of pure water
61 which came in from the sea, the sound and the Hudson river. But it is here found that there is not a great deal of difference between the quality of the incoming and outgoing currents. In some cases the currents flowing up the bay from the sea have been more polluted than those passing out on the ebb tide. It seems that, in spite of the great tidal movement, particles of sewage which are not destroyed or affected by the wind, pass back and forth indefinitely in the bay and rivers in the neighborhood of their points of origin. The action of the tide seems rather to create a diffusion and distribution of the impurities than a mechanical replacement of them by pure water.

The question of the diffusion of the water of the bay has such an important bearing on the question of the disposal of the sewage which enters it, that I have thought it worth while to collect data to show the proportions of sea water and fresh water in the bay under different circumstances.

A—Proportions of Salt and Fresh Water in New York Bay.

The commingling of the salt and fresh water is well illustrated by the records of analyses of samples of the water taken at various points in and about the harbor. For the purposes of this study the water of the ocean beyond the range of fresh water influence may be taken as averaging about 18,000 parts of chlorine per million, although it varies considerably in different parts of the sea. We may take the chlorine of Long Island sound to be about 14,000, and the Hudson at Poughkeepsie at about 1.5 parts per million.

Table 8. Proportions of salt and fresh water found at several points near the entrance of New York bay. (Chlorine results stated in parts per million.)

62

Point of collection of sample.	Date.	Tide.	Chlorine.	Approximate per cent of sea water.
Atlantic Ocean, 3 miles east of Sandy Hook Lightship	Feb. 27, 1903	Flood.	16,230	90
Opposite Sandy Hook Light	Feb. 26, 1903	Ebb...	14,700	82
Opposite Sandy Hook Light	Feb. 26, 1903	Flood.	15,300	85
Rockaway Bell Buoy	Feb. 27, 1903	Flood.	14,850	82
West Bank Light	Feb. 26, 1903	Ebb...	12,450	69
Coney Island Pier	June 11, 1904	Ebb...	18,180	100

The most striking fact exhibited by this table is the difference between the first five results and the last. The dates were widely separated, and it is probable that the first lot of samples, taken for the Commission on an Additional Water Supply for New York City, were taken after heavy rainfalls which produced freshets in the Hudson, Raritan and other rivers which empty into lower New York bay. The following tables 9 & 10 probably show more accurately the average conditions of saltness in the Lower bay.

Table 9. Proportions of salt and fresh water found along the shore of Staten Island, in the lower New York bay. The samples were collected, beginning with the one at Stapleton dock and proceeding toward Tottenville, from 1:00 P. M. to 5:40 P. M., October 22, 1904. The tide was rising, being low at the Narrows at 12:25 P. M., and high at Sandy Hook at 6:17 P. M. The wind was blowing briskly from the west with a maximum velocity of thirty miles per hour. (Chlorine results are stated in parts per million.)

Map No.	Point of collection of sample.	Chlorine.	Approximate per cent of sea water.
50	Off Tottenville	3,400	19
49	Between Wards Point and Tottenvill	3,850	21
48	Off Wards Point	5,600	31
47	Off Red Bank	13,000	72
44	Princes Bay	13,450	75
43	Seguines Point	13,300	74
42	Latourette Point	13,900	77
41	South of Great Kills	13,150	73
40	Great Kills Inshore	13,500	75
39	Great Kills	13,700	76
38	Great Kills Point	13,750	76
37	Between Great Kills and Elm Tree Beacon	13,800	77
36	Off Elm Tree Beacon	14,050	78
35	Off Midland Beach	14,000	78
34	Between Hoffman Island and South Beach	12,700	70
33	Narrows off Fort Wadsworth	12,050	67
32	Rosebank	12,350	68
31	Stapleton Dock	12,850	71

63 The first part of Table 9 shows the effects of the fresh water which enters the bay from the Raritan and Shrewsbury rivers while the last part shows the freshening effects of the outward flow from the Narrows. The water in the Lower bay beyond these influences was probably about 75% sea water.

The water in Gravesend bay was found to be somewhat less salt than that along the Staten Island shore on a day when the tide and weather permitted a fair comparison to be made between the two.

Table 10. Proportions of salt and fresh water found at several points in Gravesend bay. The samples were taken, beginning at Fort Hamilton and proceeding toward Sea Gate, between 1:45 P. M. and 3:45 P. M., October 20, 1904. The tide was rising, being high at Sandy Hook at 4:52 P. M. and at the Narrows at 5:22 P. M. The wind was light to fresh, east to south, with a maximum velocity of 13 miles per hour. (Chlorine results are stated in parts per million.)

Map No.	Point of collection of sample.	Chlorine.	Approximate per cent of sea water.
30	500 feet north of Sea Gate	12,800	71
29	200 feet north of Sea Gate	12,600	70
28	North of Pier of Atlantic Y. C.	12,800	71
27	Opposite Coney Island, half way across the Bay	12,800	71
26	Opposite Coney Island, 300 feet from shore	12,750	71
25	75 feet off Public Camp Ground	12,950	72
24	N. Y. C. Club, 100 feet off pier	13,100	73
23	Captain's Pier, 150 feet off beach	13,250	74
21	Off F. & M. Club, 20 ft. from Raft	13,350	74
22	150 feet off Avoca Villa Pier	13,250	74
20	Fort Hamilton Beach, 100 feet south of East End	13,450	75
19	Fort Hamilton Beach, 100 feet from West End	13,800	77
18	Fort Hamilton, 100 feet south	12,800	17

The water at Gravesend bay on the day when the samples reported in Table 10 were collected ranged from 70% to 77% sea water. The lower figures probably represent the effect of local dilution from Coney Island creek and upper New York bay. On
64 the whole, the salinity is remarkably uniform, the greatest difference being only about 7%.

Table 11. Proportions of salt and fresh water found at various points in the upper New York bay. The results which bear the dates February 26-27, 1903, are taken from the report of the Commission on an Additional Water Supply for the City of New York. The rest are from analyses made for the New York Bay Pollution Commission. (Chlorine results are stated in parts per million.)

Map No.	Point of collection.	Date.	Tide.	Chlorine.	Approximate per cent of sea water.
	Narrows	Feb. 26, 1903	Ebb...	11,950	66
	Narrows	Feb. 27, 1903	Flood.	9,900	55
4	Narrows	June 11, 1904	Ebb...	8,100	45
4	Narrows	June 11, 1904	Flood.	9,900	55
13	Narrows	Oct. 17, 1904	Ebb...	12,450	69
14	Narrows	Oct. 17, 1904	Ebb...	12,200	68
15	Narrows	Oct. 17, 1904	Ebb...	12,050	67
18	Narrows	Oct. 20, 1904	Flood.	12,800	71
19	Narrows	Oct. 20, 1904	Flood.	13,800	77
20	Narrows	Oct. 20, 1904	Flood.	13,450	75
33	Narrows	Oct. 22, 1904	Flood.	12,050	67
8	St. George, S. I.	Oct. 17, 1904	Flood.	8,050	45
9	Tompkinsville	Oct. 17, 1904	Flood.	9,200	51
10	Stapleton, S. I.	Oct. 17, 1904	Flood.	8,600	48
31	Stapleton, S. I.	Oct. 22, 1904	Flood.	12,850	71
11	Between Stapleton and Clifton	Oct. 17, 1904	Flood.	8,750	48
12	Rosebank	Oct. 17, 1904	Flood.	11,650	65
32	Rosebank	Oct. 22, 1904	Flood.	12,350	69
2	South of Liberty Island	June 11, 1904	Flood.	6,150	34
2	South of Liberty Island	June 11, 1904	Ebb...	6,250	35
	Battery	Feb. 27, 1903	Flood.	8,150	45
	Battery	Feb. 26, 1903	Ebb...	9,800	54
1	Pier 1, North River	June 11, 1904	Ebb...	6,550	36

In Table 11 it will be seen that the water of the Upper bay was composed of about one-third to three-fourths sea water, the rest

being land water. The proportions evidently depended upon the point where the sample was taken, and usually, to a less extent, upon the stage of the tide. In fact the action of the tide seems to have affected it but little.

But the harbor does not always contain more salt water than fresh. As early as 1856 specific gravity determinations of the water in this vicinity were made by Prof. Henry Mitchell of the
65 United States Geological Survey, and in at least two of these, one from Pier 1, North river, and the other from the Hudson at One Hundred and Fifty-second street, the proportion of sea water was less than 20%. Samples collected March 3, 1903, for the Commission on an Additional Water Supply for New York City, show that the bay on that occasion held much more fresh water than salt. As a result of analyses taken every hour from 8 A. M. to 7 P. M., the following averages were found: The tide was high at Fort Hamilton at 10:12 A. M. and 10:46 P. M.

Table 12. Proportions of salt and fresh water found at several points in upper New York bay, East river and the lower Hudson as shown by the average hourly observations of chlorine, at a time when the Hudson was discharging large quantities of fresh water. (Chlorine results stated in parts per million.)

Point of collection of sample.	Chlorine.	Approximate per cent of sea water.
Narrows	7,862	43
Battery	2,767	15
Hudson at 130th street	267	1
Hudson at Spuyten Duyvil	99.2	.5
Hudson at Alpine	21.3	.1
Hudson at Hastings	15.7	.08
East River at Brooklyn Bridge	7,435	41
East River at Blackwells Island	9,958	55
East River at First avenue	7,727	43
Harlem River at Spuyten Duyvil	433	24

Besides showing how greatly the water in the vicinity of Manhattan may be diluted by the water of the Hudson, Table 12 shows that fresh water backed up the East river, making it fresher as far as Blackwells Island, at least. Beyond that point the reduction in salinity of the Harlem river were plainly felt. Marked differences occurred in the amounts of chlorine found in the samples taken at different hours at the same points, as might
66 be expected where the salt and fresh waters were meeting and mixing actively. At one hour the water at the Narrows was only about one-quarter salt; at the Battery only about one-ninth as salt as the sea, and at One Hundred and Thirty-ninth street and the Hudson it contained only about .14% sea water.

As illustrative of the high degree of salinity which sometimes occurs at the points just mentioned the following table, 13, compiled from data obtained from the same source as the last, is useful. The samples were collected on May 28, 1903, at every hour from 8 A. M. to 7 P. M. The weather had been dry. High water occurred at Fort Hamilton at 8:48 A. M. and 9:13 P. M.

Table 13. Proportions of salt and fresh water found at several points in the Upper New York bay, East river and lower Hudson, as shown by the average of hourly observations of chlorine, at a time when the Hudson was discharging very little fresh water. (Chlorine results stated in parts per million.)

Point of collection of sample.	Chlorine.	Approximate per cent of sea water.
Narrows	13,946	77
Battery	12,517	69
Hudson — Spuyten Duyvil	7,955	44
Hudson at Yonkers	6,283	35
Hudson at Hastings	5,041	28
Hudson at Croton Point	2,379	13
Hudson at Peekskill	1,108	6
East River at Brooklyn Bridge	12,646	70
Harlem River at 125th Street	11,958	66
Harlem River at Spuyten Duyvil	8,247	46

The figures given in Table 13 show that the water at the Narrows was on this occasion three-fourths as salt as the sea; at the Battery nearly two-thirds as salt, at Yonkers nearly one-third as salt, and at Peekskill, 50 miles from the Narrows, about 6% as salt as sea water. The difference in the amount of chlorine found from hour to hour at any one station were comparatively slight, a care-
67 ful examination of the original data indicating that the mixing of salt and fresh water was not going on violently in the vicinity of New York as was the case on the day when the samples were taken for Table 12.

From these studies it is evident that the water of New York bay is not composed of fresh and salt water in any fixed proportion. It changes with the season. In the Lower bay it has been found to range from about 20% to 100% sea water according to the location of the point with reference to local sources of dilution and the amount of land water coming down the various large rivers. A fair average for the Lower bay, under ordinary conditions of weather and beyond the range of local dilution, is probably about 75%.

The water of the Narrows has been found to vary from 43% to 77% sea water, the majority of samples averaging about 65% sea water. At the Battery the samples have ranged from 15% to 69% sea water, with an average in this vicinity, under what appear to be fairly normal conditions, of about 45%.

The lower Hudson is the scene of the widest variations in the proportion of salt. In the foregoing tables it is shown that the Hudson at Spuyten Duyvil has ranged from an hourly average of 5% to an hourly average of 44% sea water for a whole day. There may be as much salt sometimes at Croton Point, as there is at others at the Battery, 33 miles away. In fact the upper limit of brackish water may be found anywhere between Yonkers and Poughkeepsie. The cause of these differences is to be found largely in the rainfall, for this furnishes the land water which flows down the Hudson and tempers the salt. In the Spring, when the discharge of the river is at its height, large quantities of fresh water

force the salt water downward toward the sea; in the late
65 Summer, when the rainfall is slight and in Winter, when the tributary streams are frozen, the salt water creeps up the Hudson to a surprising distance. Between Yonkers and West Point the limit of salt is continually fluctuating. Every tide affects it here, and as the wind may raise the water of the bay more than the tide itself, every storm has an appreciable effect in advancing or retreating the line. The flow of the currents through the Narrows, East river and Hudson seems to have little influence upon the saltness of the water in those vicinities, except at seasons when the Hudson is discharging large quantities of fresh water, when the action of the tides produces a marked effect.

b—The Phenomenon of the Underrun.

So far we have considered only the quality of the water at or near the surface. There is reason to believe that the condition of the water at the bottom is somewhat different from that at the top. Owing to its greater mineral contents the water of the sea is about 2½ times heavier than fresh water, and this difference tends to keep the two apart. The sea water seeks the bottom and the river water the top of the bay and river.

The character of the water below the surface is of special interest in this investigation for the reason that salt water tends to precipitate sewage, causing a part of its solid ingredients to settle toward the bottom. Here the water is not so capable of disposing of the sewage inoffensively. Theoretically the water at the bottom should originally hold about the same amount of oxygen as the water at the surface, but as practically all of the oxygen must come from the atmosphere, the water at the bottom is not easily replenished in case of need. When sewage is disposed of in water, the oxygen of the latter is heavily drawn upon. If enough oxygen is not avail-
able for the beneficent bacteria which decompose, oxidize
90 and render it innoxious, they disappear and their place is taken by anaerobic germs which carry on putrefaction with the production of offensive odors. Examples of this kind of sewage disposal may be seen along the water fronts of New York wherever the sewers fail to discharge into an active current, a condition of affairs which has caused considerable annoyance and led to the removal of many sewer outfalls to the outer ends of the piers.

Observations begun in 1858 show that there is sometimes a layer of distinctly salt water beneath the brackish water in the Hudson for many miles above New York. Some persons believe that there are pockets and potholes in the bottom of the channel in which salt water and sewage accumulate, until a heavy rainfall causes a rush of water down the Hudson which clears them out. This deep current is called the "underrun."

The underrun of salt water may be and usually is quite independent of the surface currents. In fact it is often directly opposed to them; there are often two distinctly opposite currents one above the other, flowing at the same time. At a gauging station established by the United States Government in 1858, between

Bedloes, now Liberty, Island and Governors Island, the velocity of the underrun moving up the river was found to exceed the velocity of the surface current moving toward the sea. The daily progress of the underrun was 21 miles, at a depth of 68 feet.

It is obvious from this and from the fact that the surface water becomes more and more salt at points up the Hudson during dry weather, that the net result of the backward and forward movement of the tides, may sometimes be to carry such elements of sewage as are not assimilated up the river, and not out to sea, as
70 is commonly supposed.

The following extract from the report of Prof. Henry Mitchell, contained in Appendix 15 of the report of the United States Coast and Geodetic Survey for 1887, p. 308, gives the opinion of the Government observers on the sanitary significance of the underrun:

"It would seem that the drainage of New York city must be storing up in August and September at the bottom of the Hudson. Some simple tests for sulphides which we employed when the underrun was first discovered, indicated that the mixture of sea and river water was recent. No 'spoiled' water in the potholes of the great central channel was found. Happily for the communities along the lower Hudson, the floods and freshets occur often enough to purge the great trench above New York city of sea water and sewer water in spite of the long inland journeys which these are prone to take in late summer and autumn—and perhaps winter."

c—Capacity of the Water of the Harbor to Digest Sewage.

If the foregoing conclusions are correct, the sewage which enters the bay is not disposed of by being carried to sea, but is assimilated by the water of the bay itself. This assimilating process is one of oxidation in which the bacteria play an important part.

Experience and experiment have shown that the digestive capacity of a water for sewage depends largely upon the supply of oxygen which the water contains. If a sufficient supply is not available, the sewage putrefies, giving off offensive odors.

Compared with fresh water streams or the ocean, the conditions in New York bay are not favorable for the disposal of sewage by assimilation. The constantly changing proportions of salt are opposed to the existence of a definite and permanent fauna and flora, and the phenomenon of the underrun shows that there is an absence of the vertical currents which are necessary for a con-
71 tinued supply of oxygen to the lower depths where the precipitating properties of the salt water are apt to carry more or less of the sewage.

The amount of sewage which can safely be discharged into fresh water is not a measure of the amount which salt water can dispose of satisfactorily, the digestive capacity of salt water being much less than that of fresh. Experiments carried on recently by Harry W. Clark for the Committee on the Charles River Dam, show that salt water normally holds less oxygen than fresh water, and that putrefaction, with the production of the exceedingly offensive gas,

sulphuretted hydrogen, is likely to occur when sewage is mixed with salt water which has not a sufficient supply of oxygen to enable the aerobic bacteria to carry on their work.

The sewage which now flows into the bay enters it in the most favorable manner possible, that is, in comparatively small amounts and at a great number of points. This aids in its general diffusion, without which no effective purification could take place.

It is impossible to say how much sewage could be discharged into New York bay without saturating it, that is, causing its supply of oxygen to become exhausted so that offensive putrefaction would become general. Already there are certain restricted localities where the water is decidedly offensive to the sight as well as to the smell. There, however, the tidal currents are sufficient to promptly carry the impurities to the main channels and there disperse them, there as yet, no trouble.

The amount of organic matter discharged into the rivers and bay in the vicinity of New York is not known with exactness, but it can be approximately determined from estimates of the amounts 72 of sewage discharged and the rainfall. The quantity of sewage discharged into the waters in the neighborhood of New York has been found to be about 455 million gallons per twenty-four hours, and the amount of drainage due to rainfall, estimated on the basis of 42 inches of rain per year and a runoff of 75 per cent, over an area of about 162 miles, is about 243 million gallons. These added together make a total of 698 million gallons of drainage wastes which the rivers and harbor receive daily.

There are no data to show the composition of this drainage, but if its composition is similiar to that of Worcester, Mass., the only American city whose mixed house and street sewage have been carefully analyzed, there are 1½ tons of solid, dry sludge for every million gallons, or 1,047 tons in it all. Of this, about one-half is organic matter.

Considered as a whole, there are no indications that the bay is being taxed beyond its capacity nor that it cannot digest considerably larger quantities of sewage, provided they are added properly, that is, through a sufficient number of outlets sufficiently far apart. What would happen if a very large amount of sewage were to be discharged at a single point is not ascertainable, but there is reason to believe that it would not be disposed of without the production of conditions which would be very objectionable if not intolerable. The chief danger is that it would not commingle promptly with the water surrounding it, in which event it might be carried to inhabited shores, creep up the Hudson with the undertow, or rise to the surface and there form an unpleasant, discolored area, as now happens in the harbor of Boston.

In considering the capacity of the bay to digest sewage, careful account should be taken of the future pollution to which it 73 will necessarily be subject as a result of the increase of population of New York city and the municipalities on its shores. Accepting the estimates of Mr. John R. Freeman, who has given very close attention to this subject of population in connection with

his studies of the future water supply of New York, it appears that the population of this area will be about double that of the present time in the year 1930. If the amount of sewage increases in proportion to the population, and the rainfall remains constant, the total increase in the amount of drainage entering the waters about New York will be about 65 per cent.

C—Industries Affected by Pollution.

The industries of New York bay which stand in any danger of being injured by such pollution as now exists, or is at all likely to occur in the future, may be classified as follows:

a. Shad fisheries.
b. Shellfish industries.
c. The passenger transportation business.
d. Excursions and bathing beaches.

These will now be considered separately:

a—Shad Fisheries.

The shad fishing industry depends upon the annual migration of the shad, Clupia Sapidissima, from the sea up the Hudson river to spawn. The most important localities for shad fishing are in Westchester, Ulster, Dutchess and Columbia counties, beside which the catch in the immediate vicinity of New York, by citizens of this State, is insignficant. Still, as the fish which are caught farther up the river must all pass through the Upper bay and lower Hudson, they are to some extent exposed to such conditions as there
74 exist. The fish begin to ascend the river in early spring. Gill nets are set for them in those parts of the river which are moderately shallow, the shoal water in the Upper bay known as the Jersey Flats being one of the spots favored by the fishermen.

It is said that some shad have been caught near the entrance of the Kill von Kull which have, when cooked, tasted strongly of kerosene, and that the discharge of liquid refuse in this vicinity from large industrial establishments has been the cause. Whether this is true or not could not be verified.

The following statistics of the shad industry in the vicinity are taken from a report of the United States Commission of Fish and Fisheries for 1902, *pp.* 449.

Table 14. Yield of shad in the vicinity of New York bay and credited to citizens of New York State in 1901.

County.	Pounds of fish.	Value.
New York	3,600	$250
Kings	45,975	2,715
Richmond	118,700	6,360
Total	170,275	$9,325

When it is considered that the shad industry of New York State yielded in 1901, 3,432,472 pounds of fish, valued at $110,682, and

was greater in that year than in any year since 1888, it does not seem likely that any pollution now in sight will do this business any harm.

b—Shellfish Industries.

The upper part of New York bay once supported oyster beds which extended from Staten Island to above Newburgh. Bedloe's Island, now called Liberty Island, was known as Oyster Is-
75 land and two small reefs just south of it were called the Little Oyster Islands. The oysters occurred here naturally and were reckoned a considerable source of wealth. They were so plentiful that the public was allowed to gather them with little or no restriction, until to-day these extensive grounds have become exhausted.* At the present time the cultivation of oysters in the bay is carried on almost exclusively below the Narrows. The Jersey Flats still furnish a small amount of natural seed, but it is doubtful if any market oysters are taken there. Attempts to raise seed in the vicinity of Piermont, just above the Palisades, recently, resulted in failure.

The value of the oyster beds in New York bay below the Narrows is very large. The principal grounds are owned by the State, on the southeast shore of Staten Island, and are let out at a nominal rent to those who apply for the privilege of cultivating them. Nearly the whole shore from a point near the mouth of the Raritan river to the neighborhood of Hoffman Island is now under cultivation, the total area of the beds being estimated at nearly 30 square miles. Prominent oystermen have estimated the yield from these islands at 500,000 bushels per annum; the Bureau of Shell Fisheries of the Forest, Fish and Game Commission has estimated it at more than four times this, and the United States Commission of Fish and Fisheries has estimated the yield at about 300,000 bushels for 1901. The value of these oysters is commonly taken to be $1 per bushel, although they sometimes bring a higher price.

76 Some clams or quahogs are taken in the same localities, but the only estimate of the quantity of these shellfish is that given by the United States Commission of Fish and Fisheries, which places the annual output at 21,900 bushels.

Table 15 gives details of the oyster business in this region as given by the Government authorities.

Table 15. Extent of the oyster and clam fisheries of Richmond county, N. Y., in 1901, as given by the United States Commission of Fish and Fisheries.

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* NOTE.—That the pollution of the waters about New York by sewage, factory drainage and garbage have also done much to destroy the natural oyster beds in this vicinity, is stated in reports of investigations of the oyster industry made in 1885–1888 by the Commissioner of Fisheries of New York State, and published as Assembly Documents No.'s 85, 1885; 28, 1887, and 37, 1888.

Items.	Number.	Value.
Persons:		
On vessels fishing	170	.....
On vessels transporting	120	.....
In shore—or boat fisheries	259	.....
Shoremen	16	.....
Total	565	.....
Vessels fishing	36	$88,900
Tonnage	477	.....
Outfit	.....	29,387
Vessels transporting	50	48,850
Tonnage	619	.....
Outfit	.....	11,847
Boats	349	42,645
Apparatus—vessel fisheries:		
Dredges	128	6,205
Tongs	40	323
Rakes	18	144
Apparatus—shore fisheries:		
Dredges	6	150
Tongs	318	2,569
Rakes	375	3,159
Shore and accessory property	.....	17,885
Total investment	.....	$252,064

Product taken.	Bushels.	Value.
Clams, hard, Public reefs	21,900	$18,485
Oysters, market, Private areas	291,841	273,617
Oysters, seed, Public reefs	8,100	3,430
Oysters, seed, Private areas	6,000	3,000
Total products	327,841	$298,532

The foregoing table does not represent the whole product of shellfish from New York bay, there being small oyster grounds and extensive clam beds in Gravesend bay, within the limits of New York city. Other localities where shellfish are taken in the vicinity
77 of New York bay, are Newark bay, Raritan river, the bend of the horseshoe, and the mouth of the Shrewsbury river. There are extensive natural seed beds in the Arthur Kill. Probably 500,000 bushels of market oysters are taken annually by citizens of New York State from the waters of the harbor within the limits of this State, and the same quantity by citizens of New Jersey from practically the same waters within the State of New Jersey.

Our analyses show that most of the oysters grown in the Lower bay are not dangerously polluted, but that those which are taken from contaminated water are practically certain to be contaminated themselves.

The oysters taken from the Staten Island beds are not always shipped direct to market, but are first taken to some convenient stream of fresh or brackish water and there allowed to remain from high to low tide. In this way the size of the oysters is greatly in-

creased. Some of these "drinking" places, as they are called, in the vicinity of New York bay are among the worst to be found anywhere. One, known as Lemon Creek, on the southeast side of Staten Island, drains a populated area of 2,010 acres and has numerous privies and other sources of pollution on its banks. Samples of water and oysters taken from the mouth of this stream have been shown by our analyses to be greatly polluted. Another, and if possible, more dangerous "drinking" ground is situated at Tompkinsville, Staten Island. The stream which furnishes such fresh water at this place affords, flows from a thickly populated area of 2,960 acres. The sewage which is discharged into the Kill von Kull on both sides of this place, within a distance of three miles, exceeds 7,000,000 gallons per 24 hours. During the season prob-
78 ably ten thousand bushels of oysters are sometimes treated here per day. Sloops come not only from the neighborhood of New York, but often from very distant points to "drink" their oysters before offering them for sale at the markets. Outbreaks of typhoid fever have been traced to oysters treated elsewhere in this way, and the "drinking" should be forbidden by law.

c—Passenger Transportation Business.

The business of transporting passengers across the bay is already large and is constantly increasing. The majority of the passengers are commuters who do business in one part of the city and live in another, or in the country, and go back and forth every day on the boats of the ferry companies.

The pollution of the bay, if unrestrained, might affect the business of these companies in two ways. The number of passengers would decrease if public health was endangered by the trip, or if the water became markedly offensive to the sight or smell. Fortunately, no amount of pollution which the growth of the cities bordering on the bay will make necessary is likely to affect the health of persons crossing the water, although it is quite conceivable that the discharge of a large amount of sewage in one spot might cause a local nuisance which would divert travel to more agreeable routes.

The extent of the transportation business in the waters about New York may be understood by the following table, compiled from data courteously supplied by the United States Steamboat Inspection service:

79 Table 16. Number of passengers carried by the principal ferries in the vicinity of New York in 1903.

Name of ferry company.	Number of passengers.	Route across.
Brooklyn Ferry Company...	33,911,317	East River.
Hoboken Ferry Company...	32,000,000	Hudson River.
Union Ferry Company.....	30,687,096	East River.
Penn. R. R. Company.....	30,337,493	Hudson River.
Erie R. R. Ferries.....	16,667,252	Hudson River.
L. I. R. R. Ferries.....	15,639,250	East River.
C. R. R. of New Jersey Ferries	10,700,862	Hudson River — New York Bay.
S. I. R. T. Ferry.....	7,929,000	New York Bay.
W. S. R. R. Ferries.....	5,873,886	Hudson River.
N. Y. and E. R. Company...	4,309,700	East River.
Nassau Ferry Company.....	2,680,000	East River.
N. Y. & S. Brooklyn Ferry Company	1,720,000	East River and New York Bay.
Fort Lee Ferry.....	1,705,659	Hudson River.
Total.....	194,161,515	

Of the total number of passengers shown in Table 16, about 8,811,000 traveled directly across the center of upper New York bay.

d—Excursions and Bathing Beaches.

For somewhat less than six months of the year excursion steamers ply about the bay and carry large numbers of passengers in search of pleasure and health. Most of these steamers have fixed destinations, such as picnic grounds and bathing beaches, but some merely sail about without landing their passengers. The total number of passengers carried by excursion steamers in the New York district in 1903 was about 2,300,000. It is obvious that any condition of the water which is capable of injuring the business of transporting commuting passengers is certain to do at least equal injury to the excursion business.

A large proportion of the people who patronize the excursion steamers do so in order that they may reach in a pleasant and expeditious manner what are called "day summer resorts." These are in reality extensive bathing beaches with hotels, restaurants and a great variety of amusement places. The largest day summer
80 resort near New York is Coney Island, with a daily attendance estimated at from 200,000 to 400,000 people. Others are Midland Beach and South Beach, on the Staten Island shore. These are all located in the Lower bay, somewhat beyond the Narrows. Millions of dollars have been invested at these day summer resorts to attract visitors and they are deservedly popular. They would suffer material loss in patronage if the water became sufficiently polluted to affect health.

Bathing is far more common in the Upper bay than is generally supposed. In the year 1903 over 3,000,000 baths were taken in the floating bath houses maintained by the city of New York on the water front.

D—Project of the Passaic Valley Sewerage Commission.

It is proposed by the Passaic Valley Sewerage Commission, acting under authority of the Legislature of the State of New Jersey, to construct a large trunk sewer which shall collect the sewage of an extensive and populous district and empty it into the waters of New York bay. The point chosen for the outfall of this sewer is about three-quarters of a mile north of Robbins Reef light, on the western edge of the main channel of the Upper bay. The discharge is to be continuous. The ultimate capacity of the sewer is to be 345,830,000 gallons per 24 hours. This is approximately 50% of the total amount of sewage from houses and streets which drains into the bay at present.

A careful examination of the published reports of the engineers whose opinions have been asked by the Passaic Valley Sewerage Commission with reference to the possibility that the proposed sewer will create a nuisance to persons or property adjacent to the
81 bay, shows that it has generally been assumed that the tides cause a more perfect flushing and cleansing than our present studies indicate. In the foregoing sections of this report we have not found that the water of the bay is renewed at every tide. Analyses have shown that there is not ordinarily a great deal of difference in the quality of the water at ebb and flood tides. Samples taken near the Narrows on the flood tide have been far from as pure as the sea. Our studies of the diffusion of the salt and fresh water in the bay lead to the conclusion that the rise and fall of the tides result largely in a backward and forward movement of the same water and that the actual renewal of pure sea and river water, except during freshets or storms, is far less than has been supposed.

In considering the possibility that the sewage of the Passaic Valley District can be discharged into New York bay without creating a nuisance, therefore, we should reject the idea that it will be promptly carried to sea and consider the probability that it can be assimilated and digested by the water of the bay in the bay and rivers about New York.

We have seen elsewhere in this report that the digestive capacity of New York bay is very large; larger than would probably be necessary for the assimilation of the sewage which will probably need to be discharged into it in the next twenty-five years. This conclusion is not based upon the assumption that sewage would be brought to the bay from communities remote from the shores of the bay, nor upon exceptional conditions such as the discharge of an enormous quantity of sewage at any particular points. Such conditions if not prevented, might easily lead to local nuisances and overcharge the water with organic matter which could only putrefy.

82 What appears to be an erroneous assumption in the reports of the engineers of the Sewerage Commission is the theory that the sewage from the Passaic Valley sewer will be rapidly diffused throughout the bay. It does not seem possible that this diffusion could be as rapid as the diffusion of smoke and vapors in the atmosphere, and we have in tall chimneys at Bayonne and Fort Lee

sufficient illustration of the fact that smoke and vapors can travel several miles without commingling with the atmosphere and disappearing from sight. Is it probable that the sewage of the Passaic Valley District would be so rapidly diffused that it would not be easy to recognize it from the decks of the boats which ply through the harbor? Precedents for the discharge of so much sewage at a single point are not numerous, but perhaps the experience of Boston may be cited as an answer.

At Deer Island, near the entrance of Boston harbor, there is an outlet of a sewer which discharges 38,300,000 gallons of sewage per day. The water near this outlet is discolored over an area of about 350 acres. When the sewage has traveled about 1⅛ miles from the outlet, which it does in about 1¼ hours, the discoloration disappears.

At Moon Island, also in Boston harbor, there is a sewer outfall which discharges 22,000,000 gallons of sewage in ¾ hour, the discharge being discontinuous and so regulated that the sewage is emptied into the harbor only during that period of the outgoing tide which is most likely to carry it to sea. The discolored area in this case is about 750 acres. Because it is not all perfectly fresh, some of this sewage is septic. It is offensive to the sight and smell over two-thirds of the discolored area.

If the conditions in Boston harbor are to be taken as an indication of what might happen in New York bay, it appears that
83 the discharge of the greater quantity of sewage which the Passaic Valley District Sewerage Commission has to deal with, would discolor about 3,000 acres or 4.7 square miles.

Setting aside, therefore, the questions of health and the ultimate saturation of the bay with organic matter, this local discoloration, with possibly the creation of offensive odors, directly in the path of ferry boats, excursion steamers and the Atlantic shipping would be a cause of serious annoyance. But it is by no means certain that the discharge of so much sewage in the centre of the tidal basin of the Upper bay would not bring about conditions injurious to the public health. The proposed outfall is within ½ mile of the pierhead line and 1¼ mile of the line of solid filling established by the U. S. Government on the New Jersey shore. It is within two miles of Staten Island and of Liberty Island, a popular point for excursions, and of Governors Island, the headquarters of the U. S. army in this district. The Brooklyn shore is about two miles away. Ellis Island, the headquarters of the U. S. Immigration Bureau, is within 2½ miles. The southern end of Manhattan is about 3¼ miles away. Immediately to the west, are the Jersey Flats comprising about 8 square miles of muddy bottom lying under about 1 to 7 feet of water at low tide. The extensive improvements of the Pennsylvania railroad are close to the proposed outfall on the north.

Summarizing the matter, it does not seem likely that the additional amount of organic matter which would be contained in the sewage which the Passaic Valley Sewerage Commission would discharge into the bay would overtax the digestive capacity of the water provided that it could be added in a way which would insure

its immediate and thorough diffusion throughout the waters of the harbor and rivers. The effect would undoubtedly be to increase the permanent effects of pollution which are already measurable and which make the waters in the vicinity of the bay less desirable than they should be for bathing and the cultivation of shellfish. But it is not believed that a complete and satisfactory diffusion of the sewage lies within the range of practical possibility. A large number of the comparatively small sewers which discharge into the bay, create local nuisances near their outfalls, and experiment shows that the disposal of sewage into water which has not sufficient oxygen to permit of its prompt decomposition by the bacteria, results in a particularly offensive kind of putrefaction. The experience of Boston is believed to furnish a fair illustration of the kind of local nuisance which could reasonably be expected if the present plan of the Passaic Valley Sewerage District Commission was carried out. The fact that the sewage at Nixon Island discharges at the surface, and at Deer Island 9 feet below the surface at high tide, while the Jersey sewer is to empty into the bay at a depth of 45 feet, seems not to have sufficient bearing upon the conditions to alter this conclusion.

Conclusions.

The studies which have been outlined in the foregoing pages have led to certain definite conclusions which, for convenience, may be briefly summarized as follows:

(1.) The effects of the present pollution of New York bay, although not great, are nevertheless measurable.

(2.) A careful study of the proportions of sea water and fresh water in the bay and rivers about New York shows that the sewage of New York city is not promptly flushed out to sea, except during freshets in the Hudson.

(3.) The water of the incoming tide is not ordinarily much purer than the water of the outgoing tide in the Upper Bay.

(4.) It is probable that most of the sewage which enters the bay is disposed of in the bay by animals and plants, chiefly the bacteria which live in this water.

(5.) The most useful effect of the tide is its production of currents whereby the sewage becomes mixed and diffused.

(6.) The drainage which now enters the bay does so in the most favorable manner possible for diffusion; that is, from a large number of outlets situated along an extensive shore line.

(7.) How much sewage and other organic matter can be emptied into the bay without killing those forms of life which now destroy it, and so creating a general nuisance, it is impossible to say. This is a matter of great importance, but its proper study requires analyses and experiments which have been beyond the reach of this commission.

(8.) Compared with fresh water streams or the ocean, New York bay is not a favorable place for the inoffensive disposal of sewage.

(9.) Should the bay become overloaded with sewage, the odors which will arise from it will be particularly offensive.

(10.) The total amount of solid matter which now enters the bay with house and street sewage, every 24 hours, is approximately equivalent to 1,047 tons of dry sludge. About one-half of this is organic matter.

(11) The bay is not likely to be polluted to such an extent that a general nuisance will occur for 25 years at least, if it is used solely for the discharge of sewage from the communities which are adjacent to its shores.

86 (12.) Long before a general nuisance is produced, local nuisances will occur, as may be seen at present to a limited extent, where sewers and drainage from industrial works empty into still, or comparatively still water.

(13.) Observations made by the U. S. Government show that a distinct current of salt water sometimes runs up the Hudson under the fresher water, without respect to surface currents, and it has been suggested that this under-run carries sewage from New York city up the river and empties it into potholes or depressions in the bed of the channel, where it remains until washed out by freshets.

(14.) The oyster beds in New York bay are almost exclusively located on the southeast side of Staten Island and Gravesend bay.

(15.) Most of the oyster and clam beds are now free from dangerous pollution, although there are some on the Staten Island shore near the Narrows and the Kill von Kull, and a few in Gravesend bay, which are nearer sewer outfalls than is proper.

(16.) Our analyses of oysters and clams show that shellfish which are grown or immersed for some hours in polluted water become polluted themselves.

(17.) The increasing amount of pollution to which the waters of New York bay are subject makes it seem only a question of time when oyster culture will be driven from this locality; but with wise and careful protection, a large part of the present oyster grounds can be kept safe for some years to come.

(18.) The almost universal custom in this vicinity of "drinking," that is, bleaching and bloating oysters in polluted streams of fresh water, places all shellfish under suspicion of being contaminated.

87 (19.) The pollution of the bay has had no visible effect upon the number of fish caught in the vicinity of New York, although petroleum and other industrial wastes appear to have occasionally affected the flavor, and consequently the value, of small catches of shad.

(20.) The transportation of passengers on ferry boats is one of the most important industries connected with the bay, the number of passengers transported in the New York district in 1903 having been 204,000,000, and the number which traveled directly across the centre of the Upper bay, 8,811,000. This business would be seriously injured if the water became offensive to the sight and smell.

(21.) Unrestricted pollution of the bay would destroy the health-

fulness and attractiveness of the parks and recreation piers which have been built by the city of New York on the water fronts for the benefit of the poor.

(22.) Excursion steamers carried about 2,300,000 passengers to bathing beaches and other day summer resorts on or near the bay in 1903. The most important of these places are located a little beyond the Narrows in the Lower bay and represent a total investment of several million dollars. The pollution of the bay will eventually injure the healthfulness and business value of these resorts, unless restricted.

(23.) The project of the Passaic Valley Sewerage Commission of New Jersey, if carried out, would ultimately empty into the centre of the upper bay 345,850,000 gallons of sewage per day from a community not adjacent to the bay.

(24.) The proposed sewer, if put into service at once, would increase the amount of house sewage and storm drainage which enters the bay by about 50 per cent.

(25.) The natural increase in population of New York and vicinity will, by 1930, increase the present amount of pollution about 65 per cent.

(26.) If the New Jersey sewer is built, the pollution of New York bay will be more than doubled in the next twenty-five years.

(27.) Since the organic matters contained in the sewage which is emptied into the bay must be destroyed by assimilation in the bay, it is evident that the discharge of so much sewage as that proposed by the Passaic Valley District Sewerage Commission must first be diffused before it can be purified. It is by no means clear that the sewage would be so diffused before reaching inhabited shores.

(28.) Precedents for the discharge of so much sewage at one point, as contemplated by the Passaic Valley District Sewerage Commission, indicate that this quantity of sewage cannot be emptied into New York bay, in accordance with the announced plans of that commission, without producing a local nuisance.

(29.) Probably the nearest approach to the conditions which might be expected is at Boston. At Deer Island in Boston harbor, the discharge of 38,300,000 gallons of sewage per day causes the water about the outlet of the sewer to be discolored over an area of 250 acres. At Moon Island, also in Boston harbor, the discharge of 22,000,000 gallons of sewage in about ¾ hour discolors about 750 acres, about two-thirds of this area being offensive to the sight and smell.

(30.) If the conditions in Boston harbor are a fair example of what would happen in New York bay, the sewage from the outfall of the Passaic Valley sewer would discolor and render more or less offensive about 3,000 acres or 4.7 square miles of the most beautiful and most traveled part of New York bay. On calm days the sleek, or thin film of grease from this sewage might reach Liberty Island, Ellis Island, Governors Island and the Battery, or Brooklyn and Staten Island.

89 APPENDIX 4.

Legislative and Documentary History of the Passaic Valley Project, and Ocean Disposal of Wastes.

By Commissioner Olin H. Landreth.

Passaic Valley Sewerage Commission.

The Legislature of New Jersey on February 26, 1896, enacted a law (being chapter 7 of the Laws of 1896) entitled "An act for the construction of a general system of sewage disposal for the Valley of the Passaic river and the prevention of the pollution thereof." This law provided for the appointment by the Governor of three citizens of New Jersey to consider the subject of the pollution of the Passaic river and for a general system of sewage disposal for the relief of the Passaic Valley. These persons were given power to employ engineering and other assistants and to report to the Legislature their conclusions, with maps, plans, methods of carrying out the work, an estimate of cost and a recommendation as to the method of apportioning the cost. The sum of ten thousand dollars was appropriated to defray expenses of this investigation.

A copy of this act in full is given on page 5, of the published report of the N. J. commission dated February 26, 1897, and forming item No. 2 of this synopsis. Governor Griggs appointed on April 21, 1896, as such commission, Messrs. Elias J. Marsh, M. D., H. C. H. Herold, M. D., and William T. Hunt, who prepared and submitted to the Legislature on February 26, 1897, their report of the Passaic Valley Sewerage Commission which forms the following item.

90 Report of the Passaic Valley Sewerage Commission Submitted February 26, 1897.

The commission organized with the following officials and advisers: E. J. Marsh, M. D., treasurer; W. D. Scott, secretary; Joseph Could, counsel; Alphonse Fteley, consulting engineer; C. E. A. Jacobsen, engineer; H. E. Abbot, A. W. Cuddleback, Robert F. Sayles, James A. Wylie, assistant engineers; Herbert B. Baldwin, chemist, and Richard N. Connolly, M. D., bacteriologist.

The report of the commission contains the individual reports of the engineers, the secretary, the chemist and the bacteriologist together with the general conclusions and recommendations of the commission including the draft of "An act providing for the purification of the rivers and streams of water within this State and to prevent the pollution of the same."

Act to Prevent the Pollution of the Upper Passaic River.

The Legislature of New Jersey enacted on March 24, 1897, (forming chapter 35 of the Laws of 1897) an act to prevent the wilful pollution of the Passaic river and the tributaries thereof above the Great Falls of the Passaic river at Paterson. This law was evidently intended to protect the purity of the potable water supply of the East Jersey Water Company and has no very important bearing on the efforts to reduce the pollution of the lower Passaic Valley.

Legislative Committee.

Owing to a strong opposition to the terms of the draft of the bill recommended by the commission of 1896 the bill was not brought up for passage but in place thereof an act was passed authorizing a committee of members of the Legislature to study the subject of and to report at the next session what should be done in the matter. The committee consisted of Senators Robert Williams, and W. M. Johnson and Assemblyman T. C. Wildman. During 1897 this committee held public meetings and listened to arguments for and against the proposed legislation. In the spring of 1898 the committee reported as a result of its labors that the whole matter ought to be studied again by a new commission and presented a bill providing for a commission of eight persons, three of whom were to be members of the original commission of 1896. The bill was passed and Governor Voorhees on Aug. 3, 1898, appointed the following commissioners: Mr. William T. Hunt, Dr. H. C. H. Herold, Dr. E. J. Marsh, Hon. John Hinchliffe, Dr. James A. Exton, Hon. Charles W. Fuller, Hon. Charles F. Harrington, and Mr. William Kent.

State Sewerage Commission.

The Legislature of 1899 on March 24th enacted a law (forming chapter 210 of the Laws of 1899) entitled "An act to prevent the pollution of the waters in this State by the establishment of a State Sewerage Commission, authorizing the creation of sewerage districts and district sewerage boards and prescribing, defining and regulating the powers and duties of such commission and such boards." This act provided for the appointment by the Governor of five citizens of the State to compose the "State Sewerage Commission," the duties of which commission are to investigate the various methods of sewage disposal and to investigate all complaints of pollution of the waters of the State and to advise as to the best methods of sewage disposal in order to prevent such pollution and to pass on, approve or disapprove of all plans for sewage disposal into the waters of the State before such systems can lawfully be built and the sum of five thousand dollars was appropriated to enable the commission to carry out the provisions of the act. The act also provided for the formation of "sewerage districts" and

the appointments of "sewerage boards" each board to comprise two members of each municipality within the district to be appointed by the governing body of each such municipality and one member to be appointed by the State Sewerage Commission. These district boards were to be considered as corporate bodies and were given powers to investigate, design, construct, maintain and operate systems of sewerage and drainage or systems of sewage disposal works or both and were given the power to condemn and appropriate lands and to issue bonds.

This act was re-enacted in a somewhat amended form by the Legislature of 1900 (forming chapter 72 of the Laws of 1900.)

It is to be noted that the functions of this State Sewerage Commission are general and are not confined to the Passaic Valley.

The first commissioners to be appointed under this act were as follows: Charles F. Harrington, Hon. John Hinchliffe, Wm. T. Hunt, Charles W. Fuller, David L. Wallace.

This State Sewerage Commission has submitted several annual reports referred to as follows:

Annual Report of State Sewerage Commission for 1899.

This report forms document No. 48 of volume V. of Legislative Documents for 1899. As no appropriation was made for the expenses of the commission no engineering investigations were made during the year, but the commission gathered a large amount of information concerning the sewerage of the cities and villages of the State on circular blanks issued by the commission. The
93 commission recommended to the Legislature that additional powers be given the commission by which they might compel the abatement of existing pollution and also recommended that authority be given to two or more municipalities to cooperate in providing sewerage and disposal. The commission also submitted a draft of a bill amending the existing law (chapter 210 of the Laws of 1899) so as to provide the above and several other proposed features.

Annual Report of the State Sewerage Commission for 1900.

This report comprises document No. 49 of volume V. of Legislative Documents for 1900. The Legislature of 1900 amended the original law establishing the State Sewerage Commission and re-enacted it as chapter 72 of the Laws of 1900. On June 4, 1900, the State Sewerage Commission adopted a resolution as follows:

Resolved, That under authority of chapter 72 of 1900 that prior to June 1, 1904, the municipalities of Paterson, Passaic, Rutherford, Newark, Orange, East Orange, Montclair, Bloomfield, Glen Ridge, Kearney, Harrison and East Newark now polluting the waters of the Passaic river with sewage, must cease to pollute the waters of the said river and make such disposal of the sewage and other polluting matter of such municipalities as shall be approved by this commission.

During the year the commission received and considered a number of complaints and petitions and passed on plans for sewerage and sewage disposal for a number of municipalities in the State. The subject of sewage disposal in Great Britain and France was investigated by Chairman William T. Hunt who inspected and reported on the system in use in London, Paris, Leeds, Manchester, Glasgow and Edinburgh. No extended engineering investigations were made by the commission during this year owing still to lack of funds.

Annual Report of State Sewerage Commission for 1901.

This report forms document No. 49 of volume V. of Legislative Documents of 1901. Governor Vorhees transferred to the commission eight thousand dollars from his emergency fund, which enabled the commission to undertake some engineering work. This work was all confined to the Passaic Valley problem as being the most important single sewerage problem in the State and consisted in the making of surveys and plans for the system of intercepting sewers extending from Paterson along Passaic river to Newark bay with plans for sewage disposal. A part of this work was undertaken by Messrs. Collin R. Wise, Robert M. Watson and William Ferguson, engineers, and the remainder by Mr. James Owen, C. E., and reports were submitted for these two divisions of the engineering work. These reports with the maps and plans accompanying them were then submitted to a board of consulting engineers comprising Messrs. Rudolph Hering, J. J. Croes and William M. Brown who examined and reported not only on the plans as already submitted, but also on alternate features. The conclusions of the board of consulting engineers were that the most efficient and economical system of disposal for the Passaic Valley from Paterson to Newark bay was a system of intercepting sewers without sewage treatment by which the entire sewage of the municipalities along the valley should be brought to New York bay. The commission also submitted a number of technical questions regarding the sewage disposal to Mr. H. W. Clark, chemist of the Massachusetts State Board of Health, and the report contains the answers of Mr. Clark on these questions. In addition to the Passaic Valley investigations the commission also considered the cases of a number of municipalities and streams throughout the State and ordered a number of municipalities to cease the pollution of certain streams at certain stipulated dates. The commission also approved during the year plans for sewerage and disposal for a number of municipalities in the State.

Annual Report of the State Sewerage Commission for 1902.

This report forms document No. 33 of Volume III, of Legislative Documents for 1902 submitted to the Legislature of 1903. The Legislature of 1902 having passed an act (chapter 48 of the Laws of 1902) establishing a separate sewer district for the Passaic

Valley and creating a commission therefor. The State commission devoted its energies to other portions of the State, placing the services of its members and the official records and material at the disposal of the Passaic Valley Sewerage Commission.

The Legislature of 1902 passed an act (chapter 49 of the Laws of 1902) which was approved March 27, 1902, providing that the Legislature might create and incorporate sewerage and drainage districts and providing for the appointment by the Governor of boards of sewerage commissioners of five residents of each such districts.

Passaic Valley District Sewerage Commission.

The Legislature of 1902 passed an act (chapter 48 of the Laws of 1902) which was approved March 27, 1902, entitled "An act to create a sewerage district to be called Passaic Valley Sewerage District."

The Governor appointed under these acts the following gentlemen to comprise the Passaic Valley Sewerage Commission:
96 Messrs. J. A. Lebkuecher, John Hinchliffe, Francis Child, Peter Houck and William McKenzie.

This commission organized on April 22, 1902, by the selection of Mr. J. A. Lebkuecher as chairman and Mr. John S. Gibson as clerk. On August 18th the commission appointed Mr. Rudolph Hering of New York as its chief engineer. This commission submitted its first annual report to the Legislature on January 23, 1903.

Annual Report of the Passaic Valley District Sewerage Commission for 1902.

This report was submitted on January 23, 1903, and contains besides the general report of the commission the report of its chief engineer Mr. Rudolph Hering and also the draft of the proposed bill which should more thoroughly provide for the carrying out of the sewerage improvements recommended by the commission.

The report of Chief Engineer Hering describes his surveys, examinations and conclusions on the study of two alternate general plans of improvement; namely, first a system of intercepting sewers extending from Paterson to Newark bay by which the sewage of this portion of the valley should be brought to a discharge into the waters of upper New York bay without purification; and second, a system of intercepting sewers, but in place of crude disposal in New York bay the use of one or more purification plants in which the sewage should be treated and the purified discharged into the Passaic river or Newark bay. Mr. Hering's conclusions favor the adoption of the former method. This system which is the one now authorized for construction comprises a main intercepting sewer extending
97 from a point near the Great Falls of the Passaic in the city of Paterson along the right and westerly bank of the Passaic river to a point in the city of Newark where it leaves the river and passes southeasterly through the city across the meadows

to a point on the shore of Newark bay about opposite West Bergen Point, where a main pumping station is to be located. Down to the site of the pumping station this is to be a gravity sewer, but two auxiliary pumping stations are proposed, one at Wallington and one at Lynhurst where sewage from low level sewers on the left bank of the Passaic river to be pumped across the river and into the main intercepting sewer. The pumping station on Newark bay is to force the sewage through two 6 feet diameter steel force mains under Newark bay and up into a gravity sewer which is on the eastern shore of Newark bay in Jersey City at the Morris and Essex canal. This gravity sewer, 13 feet in diameter, leads southeasterly along the canal to a point jutting out into New York bay near Panrapo where the sewer changes to the eight-feet steel pipe laid under New York bay up to a point about three-quarters of a mile northeast of Robbins Reef light in a depth of about 40 feet of water below the mean low tide.

This report also contains the draft of the bill which the commission recommended to the Legislature as being necessary to carry out the improvement proposed. This bill in a somewhat modified form was enacted on April 22, 1903.

The Act of April 22, 1903.

This act modified somewhat from the form recommended by the commission providing for the full powers of the comission and for the procedure to be followed in executing the sewerage improvement under consideration. One of the provisions of this act
98 was that before any work should be undertaken or obligations incurred the Passaic Valley District Sewerage Commission should investigate whether the proposed discharge of sewage into New York bay is likely to pollute the waters of said bay to such an extent or in such a degree as to cause a nuisance to persons or property within the State of New York, and required that the result of such investigation should be presented to the Governor with the opinion of the commission thereon and the reasons for their opinion; thereupon that the same should be considered by the Governor and the Attorney-General and that no work or further proceedings be taken unless the Attorney-General should in writing advise that no cause of action for damages or an injunction would arise in favor of the State of New York or any of its inhabitants by reason of such discharge of sewage into the waters of New York bay.

Special Report of the Passaic Valley District Sewerage Commission Submitted June 8, 1903.

Pursuant to the requirements of the law above quoted the Passaic Valley District Sewerage Commission investigated the subject and reported as their opinion that the discharge of the sewage from the proposed Passaic Valley sewer would not pollute the waters of New York bay to such an extent or to such a degree as to cause a nuisance to persons or property within the State of New York.

The commission submitted as a warrant for its conclusions copies of the written opinions of General Henry M. Roberts, George S. Greene, Jr., E. W. Harrison, O. H. Tittmann, William Barclay Parsons and Allan N. Spooner.

Governor Murphy's Authorization to Proceed.

Governor Murphy having examined the special report submitted by the Passaic Valley District Sewerage Commission referred
99 the same to Attorney-General McCarter for his legal opinion. The Attorney-General having examined the report and having further investigated the case advised the Governor that he found no legal objection to the building of the trunk sewer proposed and that in his opinion there would be no legal objection from the authorities of New York. Thereupon Governor Murphy authorized the sewer commissioners to proceed to the construction of the improvements contemplated.

Constitutionality of Act of April 22, 1903, Maintained by New Jersey Supreme Court.

The acts of 1902-3 were attached by writ of certiorari by the city of Paterson and a citizen of the State, the proceedings bringing up for review the validity of the resolution by the Passaic Valley District Sewerage Commission providing for an issue of $1,000,000 worth of bonds for preliminary work connected with the trunk sewer. The case was argued before three justices, two of whom sustained the constitutionality of the act, handing down their opinion July 23, 1904.

Act of April 22, 1903, Declared Unconstitutional by the New Jersey Court of Errors and Appeals.

An appeal was taken from the decision of the Supreme Court as rendered, and on March 6, 1905, the Court of Errors and Appeals, by a vote of ten to one, reversed the decision of the Supreme Court previously referred to, and declared the act of 1903 unconstitutional, as it is an attempt to delegate an essential element of the power of taxation; because if the taxing power could be deemed to be granted to the commission as a representative of the sewer district, the latter is not a political district of the State, and because if the Passaic Valley Sewerage District were a political district of the State it
100 could not be invested with the power to tax persons and property beyond its own limits.

New York State Law Authorizing an Inquiry.

On May 11, 1903, the Legislature of the State of New York enacted a law (being chapter 539 of the Laws of 1903) entitled "An act to authorize the appointment by the Government of a commission to investigate certain threatened pollution of the waters of New

York bay and making an appropriation for the expenses of such commission." On June 2, Governor Odell appointed as such commission Dr. Daniel Lewis, New York StateCommissioner of Health; Prof. Olin H. Landreth, Consulting Engineer, New York State Department of Health; Dr. George A. Soper, New York State Department of Health Representative at the Ithaca typhoid epidemic; Mr. Louis L. Tribus, Commissioner of Public Works of the Borough of Richmond, Consulting Civil and Hydraulic Engineer; and Dr. Myron S. Falk of New York, Instructor in Engineering in Columbia University.

The New York Commission after organization assigned certain lines of work to its individual members for investigation, which have been completed. The commission has held eight meetings, including two joint meetings with the New Jersey Commission and one public meeting on Staten Island; and has prosecuted several lines of inquiry. It has secured opinions on the legal questions bearing on the situation from the New York State Attorney-General and in March, 1904, submitted to the Governor a short progress report and asked for an extension of time in which to submit the final report, which was granted. It has also, at its meeting Feb. 10, 1905, formulated resolutions outlining the attitude which the commission should adopt toward the Passaic Valley sewerage question.

101 (B.)

Ocean Disposal.

Possible Ultimate Ocean Disposal of all Sewage Wastes from the Metropolitan Districts.

By Commissioner Olin H. Landreth.

The waters of the metropolitan district of New York and adjacent territory, constitute an invaluable heritage to its inhabitants. In their relations to commerce, these waters comprise the chief source of the strength of New York as a commercial metropolis; in their intersection and subdivision of the territory, while in outward appearance they are barriers to intercourse and transportation, in reality they are bonds uniting the several districts by an incomparable net-work of waterways throughout which the distribution of traffic and local transportation is carried on more conveniently, effectively and economically than if the waterways did not exist. In their climatic and sanitary relations they mitigate the heat of summer and offer breathing places and water-parks which no city could afford artificially to provide.

A large proportion of the metropolitan population of New York and adjacent territory passes twice daily over the one or another of the numerous waterways of the district; another considerable portion lives on or near the shores, and still other large numbers frequent the waters for bathing, for pleasure, and as an avenue to numerous nearby water resorts.

It is hardly needful to say that these waters, so important to the interests of the entire metropolitan district, lying both in New York State and in New Jersey, should be protected against impair-
102 ment and injury, and that existing conditions which injuriously affect them should as rapidly as possible be corrected. The most serious menace to these waters lies in their pollution by waters of a great urban district. This pollution has already reached a stage which warrants the closest consideration and the utmost concern. Even the present conditions, unsatisfactory as they are, would have been much worse but for continued past efforts and action looking to the protection of these waters. These restraining efforts have, however, been confined entirely to the matter of the disposal of street sweepings, combustible and noncombustible refuse, and garbage, and while much yet remains to be accomplished along these commendable lines of activity, a decided beneficial result has already been attained, in that a policy of treatment has been adopted, the work organized, the machinery set in motion, and the matter therefore in condition not only to yield beneficial results, but is also readily open to improvement and expansion.

These remedial activities, however, touch only one general class of pollution, namely: the city waste and garbage, which represent, when discharged into the waterways, the chief source of the sedimentary deposits and the visible suspended matter. No steps whatever have been taken, however, toward provision for the proper ultimate disposal of the sewage of this extensive district, if we except a few small municipalities whose aggregate population forms an insignificant part of the entire metropolitan population.

Up to this time the only thought has been how to conduct the sewage by the cheapest route to the nearest waterway, giving no thought whatever to its effect on the waterway and on adjacent waters. While the crude discharge of even moderate
103 amounts of sewage into the waterways is injurious to the waters, the harmful results increase at a more rapid rate than the increase in sewage discharge, and a limit is soon reached beyond which the discharge of sewage produces such obnoxious conditions of the waters as would be condemned by even low standards of quality.

The evidence now available seems to show that this limit is now not far distant and that any considerable increase in the present volume of sewage discharge into the waters of the district will be quite certain to produce decidedly aggravated conditions in those waters, which even present standards of excellence will condemn. Our present standards are, however, too low and the same advancement in public intelligence and taste which demands better public utilities, better sanitation and conditions for living and more exacting requirements in presentable and artstic surroundings, will soon insist on considering the present conditions of our metropolitan waters as repulsive and intolerable.

These two general facts, viz.: that the waters of New York and vicinity are already badly polluted, and that this pollution must of necessity rapidly become worse and soon reach an intolerable limit,

lead us to the problem of the remedy. Two general lines of relief present themselves for alternate consideration.

(1.) Improved sewage disposal for each local district or municipality within or near its own bounds.

(2.) A comprehensive scheme for ocean disposal of the crude sewage of the entire metropolitan district lying both in New York and New Jersey.

On a question of such importance and magnitude even general conclusions should be definitely adopted only after the most
104 able and exhaustive study and investigation, neither of which have the circumstances and conditions attending the appointment and work of this commission rendered possible. Such consideration, however, as it has been possible to give this question seems to point to the second plan, or that of crude discharge out to sea, as the most promising solution of the problem and one which on further investigation will probably be found most feasible and efficient.

The following conclusions appear, therefore, all that may properly be expressed:

(1.) The condition of the waters in and adjacent to the metropolitan district lying both in New York and New Jersey is rapidly approaching a limit in pollution which not only should not be passed, but which already calls for radical relief.

(2.) The two most apparent forms for such relief are:

(*a*) The installation and operation of individual systems of sewage disposal for each district or municipality and the discharge of the purified effluents into the waterways; or,

(*b*) The gathering of the crude sewage of the entire metropolitan district to several centers and the conducting or pumping of the same by one or more outlets or tunnels out to sea at a sufficient distance to insure against its return at flood tide to an extent that would injure the waters of the district.

This plan would probably make desirable the creating of an interstate metropolitan sewerage district created by treaty between the two States of New York and New Jersey and ratified by Congress, and having full administrative powers, with full provision for the questions of legislative, executive and judicial jurisdiction.

105 (3.) The conditions of appointment of this commission have not made it proper or possible to give this matter of relief that exhaustive study and investigation which the importance of the question demands, and therefore no final conclusions or recommendations can be made as between the above two plans of relief or possibly others, beyond a statement that the latter plan of ocean discharge of crude sewage of the entire district appears from the consideration given it to possess the greater advantages.

(4.) This commission is clearly of the opinion that an investigation of the best plan of relief for the waters of New York and vicinity is an urgent necessity and should be undertaken at once, and that pending the completion of such investigation and the inception of the plan of relief, no extensive or considerable changes or extensions should be made in the sewerage of such portions of the metropolitan

district as would be disturbed or sacrificed by the ultimate adoption and installation of a comprehensive scheme of improvement.

106 APPENDIX 5.

Need of the Metropolis District as a Whole and Desirability of Joint State Action.

By Commissioner Daniel Lewis.

The commission, from the very inception of its investigations, has been constantly confronted with the fact that the construction of the proposed Passaic Valley sewer is only one of many serious problems demanding legislative action for the protection of the waters of New York bay against sewage contamination.

The contention of the New Jersey Commission that because the bay is now receiving the raw sewage from 4,000,000 people, therefore an increase from an added population of 1,000,000 or more should be permitted, we believe to be untenable.

The bay is now an immense cesspool, which, like small receptacles of sewage, has a natural limit of capacity, beyond which lies danger to the health and comfort of the contiguous metropolitan district. The residents of New Jersey, who are expected to discharge their waste through the proposed sewer, are equally interested with the inhabitants of New York city in preserving the waters of the bay from further contamination.

It has been suggested, therefore, that a metropolitan sewerage district should be established, to include all sections in both New York State and New Jersey which now, or in future may sewer into the bay and its tributaries. This district, when authorized by joint State and Federal legislation, should be under the direction and control of a permanent interstate commission, with plenary power to control the discharge of all sewers hereafter constructed, as
107 well as the task of evolving a comprehensive plan for ultimately rendering the present chaotic and systemless method of sewage disposal, sanitary and suitable for all future requirements.

There seems to be no possibility of a comprehensive treatment of this great question through the action of various and constantly changing local authorities, acting independently. Manhattan may continue, as at present, to follow no system whatever, simply emptying a new sewer into North or East River at any place where grades permit, even though a recreation pier or a public bath may be already established at the same point. Brooklyn may, and probably will, carry its sewage into the sea, and thus ruin the bathing beaches within its limits, and pollute the great oyster beds therein, and Westchester county for forty miles from the city may contribute a large amount of sewage, while the State of New Jersey with its constantly increasing population, will add to its present outflow from year to year.

The necessity already exists for a central authority to not only direct, but also initiate, these great public works, upon which depend the beauty and healthfulness of the approximately 450 miles of shore within the metropolitan district.

Immediate action should be commenced to secure such an interstate commission, for the existing conditions must steadily approach the point where the public will demand relief.

In this country there is at present but one locality at all analogous to New York in this respect, viz., Boston, where a great metropolitan district empties its sewage into the harbor, but the difference in governing conditions is radical, as but one State is in control, while for New York harbor two great commonwealths would have to join forces.

108 England permitted the pollution of the Thames for centuries, but at last was compelled to purify its waters at a cost far exceedig the expense of preventing such contamination had the demands of competent judges been complied with a hundred years ago.

If New York and New Jersey should now initiate the plan above outlined the mistakes of other great municipalities could be happily avoided.

109 APPENDIX 6.

Legal Opinion.

By Attorney-General John Cunneen.

To the New York Bay Pollution Commission:

I note that you submit for my consideration the following inquiries:

"(1.) What is the status of the waters of New York harbor as to control over pollution by the federal Government and by the two States of New York and New Jersey?

"(2.) Whether the federal government would have jurisdiction over any phase of construction and operation of a large proposed trunk sewer to empty into the waters of New York harbor?

"(3.) What power, if any, has the State of New York to impose conditions upon the State of New Jersey as to constructing the proposed sewer and operating it in future?

"(4.) Whether the New York Bay Pollution Commission is authorized by law to suggest detailed plans for changes in construction of the New Jersey Sewer if same is to discharge into the waters of New York bay, and objection be made to the present plans as formulated by the New Jersey Commission?

"(5.) Whether in the event this commission finds it desirable to recommend for future consideration the establishment of a metropolitan sewerage district, covering parts of the two States of New York and New Jersey, the Legislatures of the two States have authority to establish such a district and appoint a commission having adequate powers of administration?"

(1.) In response to your query No. 1, I beg to call your attention to the provisions of a treaty entered into between the States of New York and New Jersey in the year 1833, and subsequently ratified by the Legislatures of both States and approved by Congress.

The first article of this treaty reads as follows:

110 "Article 1. The boundary line between the two States of New York and New Jersey from a point in the middle of Hudson river opposite the point on the west shore thereof, in the forty-first degree of north latitude, as heretofore ascertained and marked to the main sea, shall be the middle of the said river, of the bay of New York, of the waters between Staten Island and New Jersey, and of Raritan bay to the main sea, except as hereinafter otherwise particularly mentioned."

Among the exceptions is the following, contained in Article III. of said treaty:

"The State of New York shall have and enjoy exclusive jurisdiction of and over all the waters of the bay of New York, and of and over all the waters of Hudson river, lying west of Manhattan Island and to the south of the mouth of Spuyten Duyvil creek, and of and over the lands covered by the said waters to low water mark on the westerly or New Jersey side thereof, subject to the following rights of property and of jurisdiction of the State of New Jersey."

The treaty then proceeds to reserve to the State of New Jersey the exclusive right of property in and to the land under the water lying west of the middle of the bay of New York, and west of the middle of that part of the Hudson river which lies between Manhattan Island and New Jersey, and the exclusive jurisdiction of and over the wharves, docks and improvements made and to be made on the shore of said State, and of and over vessels aground on said shore, or fastened to any such wharf or dock, except that the said vessels shall be subject to the quarantine or health laws and laws in relation to passengers of the State of New York, which now exist or which may hereafter be passed. The right of regulating the fisheries is also reserved exclusively to the State of New Jersey on the westerly side of the middle of said waters.

The case of the People of the State of New York against Central Railroad Company of New Jersey, reported in 42 N. Y., at page 283,

111 reviews at some length the question of the rights of the two States in the waters of the Hudson river south of Spuyten Duyvil creek and west of the center of such river.

This was an action brought by the Attorney-General of the State of New York to abate as nuisances and cause the removal of certain wharves, piers and other erections extending into the harbor and river from the Jersey shore a distance of about a mile. The Court, per Smith, justice, in speaking of the provisions of Article III., which are above quoted, giving the State of New York exclusive jurisdiction over the waters of New York bay, and the Hudson river lying west of Manhattan Island and south of Spuyten Duyvil creek, and of the lands under such waters, says:

"This provision in the treaty most clearly and distinctly gives

and grants to, and vests in the State of New York, full, complete and undoubted control, government and jurisdiction of and over all the waters therein mentioned. Such was the clear intent and purpose of this provision; and so far as it was essential to the proper exercise of such jurisdiction, it gives a control also of and over the land covered by such waters. It doubtless was designed in the clause of said provision in these words: 'Of and over the lands covered by the said waters to low water mark,' to disembarrass the jurisdiction so conferred over the said water, from all pretense of right to interfere therewith arising from the legal maxim, that the owner of the soil owned all above it, cujus est solum, ajus est usque ad coelum.' So that the jurisdiction over the water should be absolute and unquestioned for all practical purposes."

The Court then goes on to point out that the rights over the water so granted to the State of New York were subject to the rights of property and of jurisdiction of the State of New Jersey, and after reviewing the several clauses of the treaty bearing on the jurisdiction of the two States within the waters in question, the following rule was deduced as to the character of the jurisidction of the State of New York:

112 "It was to be a police jurisdiction of and over all vessels, ships, boats or craft of every kind that did or might float upon the surface of said waters, and over all the elements and agents or instruments of commerce, while the same were afloat in or upon the waters of said bay and river for quarantine and health purposes, and to secure the observance of all the rules and regulations for the protection of passengers and property, and all fit governmental control designed to secure the interests of trade and commerce in said port of New York, and preserve thereupon the public peace.

"By this exception, it was designed that vessels afloat upon said bay and river should not escape or evade the quarantine laws, and the laws relating to passengers of New York, by coming to anchor on or near the New Jersey shore, or by becoming attached to the wharves or docks on said shore or adjacent thereto, but in all other particulars they were left subject to the laws of New Jersey."

And again the Court says:

"These articles, I think, properly interpreted, concur in showing that it was the intention of this treaty that both States should retain the absolute control of and over its own soil, and over anything annexed or attached to it, and over every ship, vessel, or other floating craft attached to any wharf or pier, or located in any dock upon its shore, or aground in the waters adjoining its shore, and of and over all persons living or being upon such wharves or vessels, and the property therein; and that each State intended to throw the shield of its State law, and State sovereignty, over all such ships, vessels, persons or property.

"A crime committed upon any vessel fastened to any wharf on the shore, or upon any vessel aground in the waters adjoining the shore of New Jersey, and west of the center of said river or bay, except those offenses specified in the said third article against the

quarantine or health laws, and the laws in relation to passengers of New York, would be, I think, clearly an offense against the peace and dignity of New Jersey, cognizable exclusively in her courts."

It was accordingly held in this case that the Courts of this State had no jurisdiction to restrain the erection or order the removal of the structures complained of.

113 It has, however, been since held, in the case of Ferguson vs. Ross, 126 N. Y., 459, that an action to recover a penalty for an alleged violation of the provisions of chapter 414 of the Laws of 1885, amending chapter 604 of the Laws of 1875, prohibiting the deposit of any material dredged or excavated from a slip, basin or other place in the North or East rivers, or in the bay of New York, within the jurisdiction of the State of New York, might be recovered in an action in the Courts of this State, where such dredgings were deposited in the waters west of the center of the Hudson river and south of Spuyten Duyvil creek, and the right of the State of New York to pass a law imposing such a penalty was upheld.

From a persual of these two cases, it will be seen that the jurisdiction of the State of New York in and to all the waters of the Hudson river and New York bay is primarily a police jurisdiction river and south of Spuyten Duyvil creek, and the right of the State of New Jersey to erect wharves, piers, bulkheads and improvements from its shores into such waters is specifically upheld in the Central Railroad case, from which I have above quoted.

Over and above the rights of the two contiguous States is the right of the federal government in the navigable waters of New York bay and the Hudson river, in so far as the protection of navigation is concerned. (See State of Pennsylvania vs. Wheeling Bridge Company, et al., 13 Howard, 518.)

(2.) In response to the second inquiry, as to "Whether the federal government would have jurisdiction over any phase of construction and operation of a large proposed trunk sewer to empty into the waters of New York harbor," I beg to call your attention to the facts relative to such sewer in the particular case under consideration.

114 In 1902 the Legislature of New Jersey established what was known as the Passaic Valley Sewerage District, which embraced a large number of municipalities and parts of municipalities in the counties of Passaic, Bergen, Hudson and Essex, and at a special session of the Legislature of 1903, an act was passed to relieve from pollution the rivers and streams within such Passaic Valley Sewerage District, and providing for the raising, collecting and expenditure of the necessary moneys.

The plans of the commission appointed under these acts provide for the emptying of the sewage from the district in question, which is estimated to contain nearly one million and five hundred thousand inhabitants, into the waters of New York bay near Bedloes Island on the New Jersey side of the State line, as defined in Article III, of the treaty hereinbefore quoted from.

No facts have been submitted as to whether or not the construction of the proposed sewer and its operation would, as matter of

fact, interfere with the navigation of the Hudson river and New York bay. If there is any such interference, I am of the opinion that the federal government might and would interpose and assert its rights to free such river or harbor from such obstruction or interference with navigation.

As to the jurisdiction of the federal government in the matter, it would seem to me that under the authority of the State of Missouri vs. State of Illinois, and the Sanitary District of Chicago, the Supreme Court of the United States would have original jurisdiction in any proceeding which might be instituted by the State of New York to restrain the construction or operation of the proposed sewer.

The case above mentioned arose in regard to the construction and operation of the so-called Chicago Drainage canal, whereby
115 the sewage from the city of Chicago was, through the intermediate channels of the Drainage canal and the Illinois river, emptied into the Mississippi river, which at that point runs between the States of Illinois and Missouri.

The State of Missouri sought in the Supreme Court of the United States to restrain the emptying of such sewage into the Mississippi river. The bill in the action was demurred to, but the Court sustained the right of the State of Missouri to maintain its proceeding. The Court said:

"An inspection of the bill discloses that the nature of the inquiry complained of is such that an adequate remedy can only be found in this Court at the suit of the State of Missouri. It is true that no question of boundary is involved, nor of direct property rights belonging to the complainant State. But it must be surely conceded that, if the health and comfort of the inhabitants of a State are threatened, the State is the proper party to represent and defend them. If Missouri were an independent and sovereign State all must admit that she could seek a remedy by negotiation, and, that failing, by force. Diplomatic powers and the right to make war having been surrendered to the general government, it was to be expected that upon the latter would be devolved the duty of providing a remedy, and that remedy, we think, is found in the constitutional provisions we are considering.

"The allegations of the bill plainly present such a case. The health and comfort of the large communities inhabiting those parts of the State situated on the Mississippi river are not alone concerned, but contagious and typhoidal diseases introduced in the river communities may spread themselves throughout the territory of the State. Moreover, substantial impairment and prosperity of the towns and cities of the State situated on the Mississippi river, including its commercial metropolis, would injuriously affect the entire State."

The above reason would apply with equal force to the case under consideration. The sewage from territory inhabited by a million
116 and a half of people, cast into the waters of New York harbor, in addition to the sewage already emptied into those waters, might easily create a condition which would injure the health

of the great city of New York, which is the metropolis not only of the State, but of the country.

It is, therefore, quite clear to my mind that should such a condition arise, the State of New York would be authorized to begin proceedings in the Supreme Court of the United States to compel the State of New Jersey and the Passaic Valley Sewerage District to refrain from polluting the waters of New York harbor with this great mass of sewage.

(3.) In response to your third inquiry, I beg to inform you that while the State of New York can, of course, enter into any negotiations it sees fit with the State of New Jersey, yet it cannot impose and enforce any conditions in reference to the construction and operation of such sewer, upon the Passaic Valley Sewerage District or the State of New Jersey, which would be enforcible in any other way than by a proceeding in the United States Supreme Court, to restrain the use and operation of such sewer. In other words, while under the authority of Ferguson vs. Ross, above cited, the State of New York might pass a law prescribing a penalty for dumping sewage in the waters of New York harbor or the Hudson river as far west as low water mark on the New Jersey shore, yet I am of the opinion that such a penalty could not be enforced or collected as against the State of New Jersey or the Passaic Valley Sewerage District, in the Courts of this State, and that, therefore, the proper forum from which to seek redress would be the United States Supreme Court.

(4.) In response to your fourth inquiry, I beg to call your attention to the statute creating the investigating commission of this State. Section two thereof provides as follows:

117 "Such commission shall confer with the authorities of the State of New Jersey, take the testimony of witnesses, if necessary, and otherwise make such investigations as it may deem advisable, to determine the character of such threatened pollution, if any, and the means necessary to effectually prevent the same, in order to protect the health of the people of this State."

In view of the fact that the State of New Jersey would in no way be bound to act upon any specific recommendations or suggestions of detailed plans for changes of the construction of the sewer in question, I see no reason why your commission might not submit such suggestions and recommendations, if it saw fit, the same as it might submit the same at any oral conference had under the provisions of the sections above quoted with the authorities of the State of New Jersey.

(5.) As to the fifth and last inquiry, I am of the opinion that the States of New York and New Jersey may, if they see fit, construct a metropolitan sewerage district, covering parts of the territory of the two States, and giving jurisdiction thereover to the Courts of one of the other of said two States, as to all matters pertaining to the proper sewerage of said district. Such concurrent acts of the States of New York and New Jersey should, however, in my judgment, be approved and ratified by an act of Congress, for the reasons hereinbefore set forth, namely, that the federal government

has supreme control over the navigable waters of the Hudson river and New York bay, and its approval should therefore be had to the joint action of the contiguous States.

As to the power of the Attorney-General to proceed against the State of New Jersey and the Passaic Valley Sewerage District to restrain the construction or operation of the proposed sewer, I am of the opinion that section 52 of the Executive law, which
118 gives to the Attorney-General power to "prosecute and defend all actions and proceedings in which the State is interested," is broad enough in its terms to include the authority to begin such restraining action. In support of this theory, it will be noted the right of the Attorney-General to begin a similar action does not seem to have been questioned in the case of the People vs. The Central Railroad of New Jersey, hereinbefore quoted from, and the case of Missouri vs. Illinois specifically holds that the pollution of a navigable stream is a matter in which the State is interested, and therefore a proper one for its legal representatives to act in behalf of the State.

119 APPENDIX 7.

New York Law—Authorizing Appointment of Commission.

General—All Counties.

Laws of New York—By Authority.

(Every law, unless a different time shall be prescribed therein, shall not take effect until the twentieth day after it shall become a law. Section 43, article II, chapter 8, General Laws.

Chapter 539.

An Act to authorize the appointment by the Governor of a commission to investigate certain threatened pollution of the waters of New York bay, and making an appropriation for the expenses of such commission.

Became a law, May 11, 1903, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The Governor is hereby authorized to appoint a commission, consisting of five members, to investigate the alleged contemplated construction of a sewer or sewers in the State of New Jersey and the discharge therefrom of sewage into the waters of New York bay. The members of such commission shall receive no compensation for their services, but shall be entitled to their actual necessary traveling and other expenses incurred in the performance of

their duties. Such commission shall organize by the selection of one of its members as chairman and another as secretary.

120 §2. Such commission shall confer with the authorities of the State of New Jersey, take the testimony of witnesses, if necessary, and otherwise make such investigations as it may deem advisible to determine the character of such threatened pollution, if any, and the means necessary to effectually prevent the same, in order to protect the health of the people of this State.

§3. Each member of such commission shall have the power to administer oaths, and the commission shall have power to subpœna witnesses and take testimony, and in addition shall have all the powers of legislative committees as provided by article three of the Legislative Law. On or before February first, nineteen hundred and four, the commission shall report to the Governor the result of its investigation, together with such recommendations as to needed legislation or other action on the part of the State to prevent the pollution of the waters of New York bay from the causes specified in this act, as it may deem advisable.

§4. The sum of two thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any moneys in the treasury, not otherwise appropriated, for the purposes of this act, to be paid by the treasurer on the warrant of the comptroller, on the order of the chairman of such commission.

§5. This act shall take effect immediately.

STATE OF NEW YORK,
Office of the Secretary of State, ss:

I have compared the preceding with the original law on file in this office, and do hereby certify that the same is a correct transcript therefrom and of the whole of said original law.

JOHN F. O'BRIEN,
Secretary of State.

121 APPENDIX 8.

An Act to Provide for the Appointment of a Metropolitan Sewerage Commission and Making an Appropriation Therefor.

The people of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The Governor is hereby authorized to appoint within thirty days after the passage of this act five citizens of the State, two at least of whom shall be residents of the city of New York, who together with the State Engineer and Surveyor, the State Attorney-General and the Mayor of the city of New York shall constitute a temporary commission to be known as the New York Metropolitan Sewerage Commission. One at least of the five citizen members should be a lawyer and two at least should be civil engineers.

§2. The duties of this commission shall be to continue the work of the New York Bay Pollution Commission established by chap-

ter five hundred and thirty-nine of the Laws of nineteen hundred and three and to extend the work of this commission so as to include the following duties:

(1.) To make further investigations into the present and probable future condition of the purity and pollution of the waters of New York bay, and of the rivers and other bodies of water tributary thereto and adjacent to the several boroughs of New York city and its neighboring districts.

(2.) To consider and investigate the present conditions and the future needs for sewerage and sewage disposal in New York
122 city and in the adjoining municipalities and neighboring districts.

(3.) To cooperate with any duly authorized body or commission having similar authority from the State of New Jersey, in the joint consideration of the most effective, efficient and feasible means of permanently improving and protecting the purity of the waters of New York bay and of the rivers and other bodies of water tributary and adjacent thereto, making, in addition to other inquiries, examinations, investigations and surveys to determine the best plan for the final disposal of the sewage of the entire metropolitan district lying in both States, either by discharging or pumping the same through large outlet sewers or tunnels out to sea, or by other means; and also giving particular consideration to the best system of administrative control for the inception, execution and operation of such plans for ultimate sewage disposal by a separate and distinct sewerage district and a permanent commission in each State, or by one interstate metropolitan sewerage district and commission to be established by an agreement between the two States; if necessary, to be ratified by Congress, or by other means.

(4.) To submit to the Legislature in writing on or before February first, nineteen hundred and eight, a full and complete report of its investigations, surveys and estimates of cost of the several plans deemed worthy of especial consideration. Also to submit such definite conclusions and recommendations as may have been reached conjointly by the Metropolitan Sewerage Commission herein established acting in conjunction with any similar body appointed by the State of New Jersey, relating to the most effective, efficient and feasible means or plan of permanently improving and protecting the purity of the waters of New York bay and of the rivers and other
123 bodies of water tributary and adjacent thereto, as well as a definite scheme for the administration of the inception, execution, permanent operation and government of such means or plan of improvement and protection.

§3. The members of the New York Metropolitan Sewerage Commission herein provided for, shall before entering upon the discharge of their duties take and subscribe the constitutional oath of office and file the same with the Secretary of State. They shall within twenty days after appointment, and at the call of the State Engineer, meet at the office of the latter in Albany and shall organize by the selection of one of the members to be chairman of the commission and another to be its secretary.

The commission may engage such engineering, legal, and other expert services and advice, and such clerical, stenographic and other assistance as it may deem necessary for the prosecution of its duties.

§4. Each member of the commission shall have the power to administer oaths, and the commission shall have the power to subpœna witnesses and take testimony, and in addition shall have all the powers of legislative committees as provided by article three of the Legislative Law. The members of the commission and all persons duly authorized by the commission shall have the right of entry and passage to any place or property for the purpose of making surveys or examinations.

§5. The commission shall terminate on February 1, 1908, and all maps, results or surveys and examinations, estimates and other papers and matter acquired by the commission shall be properly indexed and labelled and turned over to the State Engineer and Surveyor.

124 §6. The members of the commission shall receive no salary but shall be paid their reasonable and necessary expenses actually incurred in the prosecution of their duties, and the five citizen members shall be each paid a just and reasonable per diem compensation, to be determined by the Governor, for the time actually and necessarily employed on the work of the commission.

§7. The sum of fifteen thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of any money in the treasury not otherwise appropriated, for the purposes of this act, to be paid by the State Treasurer on the warrant of the Comptroller on the order of the chairman of the commission.

§8. The Secretary of State is hereby authorized and requested to communicate with the Governor of the State of New Jersey, transmitting with the Governor of the State of New Jersey, transmitting a copy of this act and to extend through him an invitation to the State of New Jersey to cooperate with the State of New York in the carrying out of the purposes to be attained by this act and to appoint a commission to represent the State of New Jersey and unite with the New York commission authorized by this act in the investigations, surveys, conclusions and recommendations herein provided, it being desired that, if possible, the two commissions may reach similar conclusions and agree on a common plan for the accomplishment of the purposes to be attained by this act, and that they may submit identical or similar reports and recommendations to their respective legislatures.

§9. This act shall take effect immediately.

125 APPENDIX 9.

List of Meetings Held by the Commission and Special Features Considered Thereat.

June 30, 1903—All members of the commission present (five).
Meeting held on board New York State Board of Health Steamer "Governor R. P. Flower."
Inspection of New York harbor; organization of commission; Dr. Daniel Lewis, chairman; Louis L. Tribus, secretary. Assignment of subjects to members of commission for special individual investigation.
November 30, 1903—Four members of the commission present.
Meeting held in New York city.
Consideration of important details of New Jersey project; authorization given for special trips of investigation of sewage disposal systems.
December 22, 1903—All members of the commission present.
Meeting held in office of the President of the Borough of Richmond, New Brighton, S. I.
Public hearing and testimony, taken under oath, of pilots, etc., as to tidal currents, and discussion of shellfish industries and location of beds.
January 22, 1904—All members of the commission present.
Joint session of New York Commission and Passaic Valley District Sewerage Commission.
126 Meeting held in New York city.
General and free discussion of New Jersey project.
February 5, 1904—All members of the commission present.
Meeting held in office of the State Commissioner of Health at Albany.
Discussion of proposed report and topics to be considered therein. Consultation with Deputy Attorney-General upon legal questions involved in report.
February 12, 1904—All members of the commission present.
Joint session of New York Commission and Passaic Valley District Sewerage Commission.
Meeting held in office of the latter in Newark, N. J.
General discussion of details of New Jersey project and hearing of arguments of the engineers of the Passaic Valley Commission in answer to written questions previously presented by the New York Commission.
February 10, 1905—All members of the commission present.
Meeting held in New York city.
Discussion of individual reports presented by members of the commission upon their special investigations to date. Selection of features for final report, and general form of recommendations to be incorporated in a legislative bill.
March 10, 1905—All members of the commission present.
Meeting held in New York city.

Discussion of draft of final report as prepared by the Secretary.

The Secretary authorized to complete same with amendments
127 as suggested, and with the chairman to present it personally to the Governor at the earliest feasible date. To have report printed as soon as possible thereafter, for general distribution.

128 APPENDIX 10.

Financial Statement.

Appropriation				$2,000 00
Disbursements:				
1903.				
Oct. 15.	Evening Union Co., stationery and printing.	$12 65		
Dec. 10.	Louis L. Tribus, Secretary, traveling, postage and typewriting.	41 05		
March 14.	Louis L. Tribus, Secretary, traveling, postage and typewriting.	67 71		
	John P. Martin traveling and stenographic service	356 37		
May 26.	Daniel Lewis, traveling expense	48 75		
July 26.	Louis L. Tribus, Secretary draft of map and typewriting	90 16		
	Olin H. Landreth, traveling and typewriting	123 54		
			$740 23	
Accounts due:				
1905.				
	George A. Soper, traveling and analyses	$484 40		
129	Myron S. Falk, traveling and typewriting	13 94		
	Olin H. Landreth, traveling and typewriting	36 18		
	Louis L. Tribus, Secretary, traveling, map exhibit, report binders and typewriting	246 60		
			781 12	
				$1,521 35
Balance towards final petty expenses and publication of report				$478 65

130 APPENDIX 11.

Names of Those Rendering Special Assistance to Commission.

Bauer, Jacob L., Civil Engineer, Elizabeth, N. J.
Bender Hygienic Laboratory, Albany, N. Y.
Bridgman, Edw. C., Map Publisher, New York.
Brown, Wm. M., Chief Engineer Metropolitan Sewerage Commission, Boston, Mass.
Cantor, Jacob A., President Borough of Manhattan, New York.
Cassidy, Joseph, President Borough of Queens, New York.
Church, Sanford T., Deputy Attorney-General, Albany, N. Y.
Cooper, Sam'l L., Commissioner Public Works, Yonkers, N. Y.
Cromwell, George, President Borough of Richmond, New York.
Cunneen, John, Attorney-General, Albany, N. Y.
Fetherston, John T., Civil Engineer, New Brighton, N. Y.
Forest, Fish and Game Commission, Albany, N. Y.
Freeman, L. W., Civil Engineer, Mariners Harbor, N. Y.
Glorieux, Wm. L., President South Orange, etc., Joint Sewer Commission, Irvington, N. J.
Grabkowitz, J. M., Draughtsman, New Brighton, N. Y.
Grunenthal, A. F., Draughtsman, New Brighton, N. Y.
Haffen, Louis F., President Borough of The Bronx, New York.
Harrison, E. W., Civil Engineer, Jersey City, N. J.
Hommann, C. C., Civil Engineer, Perth Amboy, N. J.
Housman, Jacob, Oyster Dealer, Mariners Harbor, N. Y.
Jackson, Daniel D., Chemist, Brooklyn, N. Y.
Kohler, Capt. C. H., Superintendent Staten Island Rapid Transit Ferry Company, New Brighton, N. Y.
131 Lennon, John J., Stenographer, New Brighton, N. Y.
Livingston, George, Commissioner of Public Works, Borough of Manhattan, New York.
Loomis, Horace, Chief Engineer Sewers, Borough of Manhattan, New York.
Luster, W. H., Jr., Civil Engineer, Elizabeth, N. J.
Mackenzie, Gen. A., Acting Chief of Engineers, U. S. Army, Washington, D. C.
Marshall, Chas. A., Secretary to the Commissioner of Public Works, Borough of Richmond, New York.
Marshall, Lieut.-Col. W. L., U. S. Engineer Corps, New York.
Martin, John P., Court Stenographer, New York.
Massa, Chas. G., Civil Engineer, Fort Lee, N. J.
Muirhead, Chas. H., Mayor, South Orange, N. J.
McCann, Thos. H., Civil Engineer, Hoboken, N. J.
Musgrave, Francis W., Stenographer, New Brighton, N. Y.
Oxholm, Theodor S., Civil Engineer, West New Brighton, N. Y.
Pearce, Dr. R. M., Director of Bender Laboratory, Albany, N. Y.
Potter, Alexander, Civil Engineer, New York.
Raymond, Lieut.-Col. C. W., U. S. Engineer Corps, New York.
Redfield, Wm. C., Commissioner of Public Works, Borough of Brooklyn, New York.

Ryan, P. J., Mayor, Elizabeth, N. J.

Seehusen, Ernest H., Superintendent Bureau of Sewers, Borough of Richmond, New York.

Silva, J. J., Quarter-master Staten Island Rapid Transit Ferry Company, New Brighton, N. Y.

Stickney, Col. Amos, U. S. Engineer Corps, New York.

Suter, Col. Chas. R., U. S. Engineer Corps, New York.

132 Swanstrom, J. Edward, President Borough of Brooklyn, New York.

Thatcher, John, Superintendent Bureau of Sewers, Borough of Brooklyn, New York.

United States Census Bureau, Washington, D. C.

United States Commission of Fish and Fisheries, Washington, D. C.

United States Steamboat Inspection Service, New York.

Van Pelt, Capt. F. P., Superintendent New York, New Jersey and Sandy Hook Pilots' Association, New York.

Whittemore, Walter F., Civil Engineer, Hoboken, N. J.

Wyeth, Charles, New York State Surveyor of Oyster Lands, New York.

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136 University of the State of New York.

STATE OF NEW YORK,
Office of the Commissioner of Education, ss:

I have compared the annexed copy of Senate Document No. 39, for the year 1905 with the copy of the same deposited in the New York State Library, and do hereby certify that the same is a correct copy thereof and of the whole thereof.

[Seal State of New York, Education Department.]

PLINY T. SEXTON,
Vice Chancellor of the University, Acting
Commissioner of Education.

1 EXHIBIT No. 3.

James D. Maher, Commissioner.

STATE OF NEW YORK:

Report of the New York Bay Pollution Commission to Hon. Frank Wayland Higgins, Governor, April 30, 1906.

Commissioners: Daniel Lewis, Chairman, Olin H. Landreth, Myron S. Falk, George A. Soper, Louis L. Tribus, Secretary.

Transmitted to the Legislature May 3, 1906.

(Here insert map marked page 1 Exhibit No. 3.)

2 STATE OF NEW YORK:

Report of the New York Bay Pollution Commission to Hon. Frank Wayland Higgins, Governor, April 30, 1906.

Commissioners: Daniel Lewis, Chairman; Olin H. Landreth, Myron S. Falk, George A. Soper; Louis L. Tribus, Secretary.

Transmitted to the Legislature May 3, 1906.

3 STATE OF NEW YORK:

No. 76.

In Assembly, May 3, 1906.

Second and Final Report of the New York Bay Pollution Commission to Frank Wayland Higgins, Governor of the State.

STATE OF NEW YORK:

EXECUTIVE CHAMBER,
ALBANY, May 3, 1906.

To the Legislature:

I herewith submit the report of the New York Bay Pollution Commission.

FRANK W. HIGGINS.

NEW YORK, April 30, 1906.

Hon. Frank Wayland Higgins, Governor, State of New York, Albany, N. Y.:

SIR: Under date March 31, 1905, the New York Bay Pollution Commission presented to you its report of investigations
4 carried on during the two preceding years concerning the condition of the waters of New York Bay and vicinity, and making certain recommendations. As the presentation of our report was unavoidably delayed until nearly the close of the legislative session; acting on your suggestion, the Legislature continued the life of the commission for another year, and made a small appropriation for its expenses, rather than at that late date taking up the question of authorizing the appointment of a new commission with broader powers, and an appropriation sufficient to carry on much further the work begun. With the small sum of money at its command, the commission has been unable to do other than continue in a small way some of the examinations which it felt to be most essential, namely, bacteriological and sanitary examinations of the waters and shores of the harbor. The accompanying report of the sub-committee (Appendix) confirms quite strikingly the conclusions arrived at by the earlier investigations, as reported upon last year, demon-

strating still more clearly the need for full study and the earliest possible consideration of the whole question of preventing the further pollution of the waters in question and the ultimate doing away with even the present causes of contamination.

Certain objections had been made to the form of the bill which the commission suggested a year ago, so that a new measure has been under consideration for this year's action, similar in its general purport but differing in some special details.

The technical journals and the daily press of New York city have given much publicity to the matters reported upon, and commend very fully the work already done and that proposed for the future. The Chamber of Commerce of the State of New York, the Merchants' Association of New York, the Board of Trade
7 & 6 and Transportation, the Maritime Association of the Port of New York, the New York Produce Exchange, the City Club, the American Scenic and Historic Preservation Society, the Municipal Engineers of New York City, and other representative bodies have given evidences of being very much alive to the necessity of the case.

The status of the New Jersey legislation remains unchanged since our last report, except that a special session of the New Jersey Legislature is likely to be called in September to consider the subject very fully.

There has been so great an interest taken in this matter, that the commission would ask for the printing of an additional edition of its former report, the present one having long since become practically exhausted. It would seem desirable to have such edition made an appendix of this report, so that all those interested in the subject may readily compare this year's results with those formerly presented.

Respectfully submitted,

NEW YORK BAY POLLUTION COMMISSION.
DANIEL LEWIS *Chairman*.
OLIN H. LANDRETH.
GEORGE A. SOPER.
MYRON S. FALK.
LOUIS L. TRIBUS, *Secretary*.

Report on the Sanitary Conditions of New York Bay as Shown by Chemical and Bacteriological Analyses of the Waters and Inspections of the Shores.

By George A. Soper, Special Committee, April 30, 1906.

9 The Sanitary Condition of New York Bay as Shown by Chemical and Bacteriological Analyses of the Waters and Inspections of the Shores.

By Commissioner George A. Soper.

The sanitary examinations of the waters of New York Bay and vicinity recorded in the first report of the New York Bay Pollution Commission, made May 1, 1905, have since been continued and extended. The conclusions hitherto reached have been, for the most part, fully confirmed by the studies of the last year.

Before undertaking to consider the most recent work of the commission, the more essential of the conclusions already reached may be repeated:

(1.) The effects of the present pollution of New York Bay, although not great, are nevertheless measurable.

(2.) A careful study of the water in the bay and rivers about New York shows that the sewage of New York City is not promptly flushed out to sea, except during freshets in the Hudson.

(3.) It is probable that most of the sewage which enters the bay is disposed of in the bay by animals and plants, chiefly the bacteria which live in this water.

(4.) The drainage which now enters the bay does so in the most favorable manner possible for diffusion; that is, from a large number of outlets situated along an extensive shore line.

10 (5.) How much sewage and other organic matter can be emptied into the bay without killing those forms of life which now destroy the sewage and so creating a general nuisance, it is impossible to say. This is a matter of great importance, but its proper study requires analyses and experiments which have been beyond the reach of this commission.

(6.) Compared with fresh water streams or the ocean, New York Bay is not a favorable place for the inoffensive disposal of sewage.

(7.) Should the bay become overloaded with sewage, the odors which would arise from it would be particularly offensive.

(8.) The total amount of solid matter which now enters the bay with house and street sewage every twenty-four hours is approximately equivalent to 1,047 tons of dry sludge. About one-half of this is organic matter.

(9.) Long before a general nuisance is produced, local nuisances will occur, as may be seen at present where sewage and drainage

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from industrial works empty into still, or comparatively still water in this vicinity.

(10.) The oyster beds in New York Bay are almost exclusively located on the southeast side of Staten Island and Gravesend Bay, beyond the Narrows.

(11.) Most of the oyster and clam beds are now free from dangerous pollution, although there are some on the Staten Island shore near the Narrows and the Kill von Kull, and some in Gravesend Bay, which are nearer sewer outfalls than is proper.

(12.) The increasing amount of pollution to which the waters of New York Bay are subject makes it seem only a question of time when oyster culture will be driven from this locality; but
11 with wise and careful protection, a large part of the present oyster grounds can be kept safe for some years to come.

(13.) The almost universal custom in this vicinity of "drinking," that is, bleaching and bloating oysters in polluted streams of fresh water, places all shellfish under suspicion of being contaminated.

(14.) The pollution of the bay has had no visible effect upon the number of fish caught in the vicinity of New York, although petroleum and other industrial wastes appear to have occasionally affected the flavor, and consequently the value, of small catches of shad.

(15.) The natural increase in population of New York and vicinity will, by 1930, probably increase the present amount of pollution about 65 per cent.

The principal points of information sought in the recent work of the commission have been—(1) To determine whether the waters of New York Bay were comparatively uniform in quality at all depths, or whether a perfect mixture of the salt water, fresh water and sewage which entered it did not occur; (2) Whether the waters of the East River, Harlem River and Hudson River bore positive evidence of pollution; (3) Whether the supply of oxygen was always sufficient for the oxidation of the organic matter by the bacteria.

The analyses have been confined to chemical and bacteriological determinations uniform in character with those recorded in the first report of the commission. The methods of analysis and the ways of expressing the results have been the same. There have been one hundred and fifteen chemical analyses and the same
12 number of bacteriological examinations. As a rule, samples for chemical and bacteriological analyses were collected simultaneously. The total number of analyses was very small, considering the size of the problem to be studied.

The great extent of the harbor and its tributaries and the multiplicity of the conditions of pollution and purification which called for investigation needed far more extensive analytical studies than the slender means of the commission permitted. The analytic work done thus far should be regarded only as an indication of the great value and meaning which would attach to similar work if carried out on a large scale.

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It is hoped, if further studies are to be made of the conditions of these waters, that opportunities will be afforded for keeping the harbor and adjacent waters under adequate observation for at least one full year. Facilities should be provided for the collection and analysis of several thousand samples.

The numbers of bacteria found were, in most cases, smaller than would be expected from the results of analyses published by the commission in its first report. The numbers would have been larger had the observations been made in the summer season, for cold exercises a restraining action on the growth and multiplication of bacteria.

A sanitary inspection of the shores of the bay was made in order to discover, if possible, whether any visble evidence of pollution by sewage, garbage or other refuse existed there. This inspection yielded unexpectedly interesting and instructive results.

13 A—Results of Bacteriological Analyses.

Analyses were made to determine the numbers of bacteria in the waters and, to some extent, their kind. The principal kind looked for was B. coli, an invariable accompaniment of sewage. The examinations for B. coli were made by the "presumptive test," already described in the first report of the New York Bay Pollution Commission, and checked by means of a special method which has come into regular use at the Mount Prospect laboratory, Brooklyn, N. Y. This method has not yet been published and cannot, consequently, be fully described here. It will be known as the "bile lactose method" and was devised by Mr. D. D. Jackson into whose hands the actual work of the bacteriological and chemical analyses for the commission has been intrusted. ,

1. Bacteria at Different Depths in Upper New York Bay.

Samples of water were taken for analysis at different depths in upper New York Bay to determine whether there was an appreciable difference in the bacterial condition of the water at the surface and at different points toward the bottom. The results are given in tables 1 and 2.

Table 1. Results of bacterial analyses of water taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 28, 1906, between 10:00 a. m. and 3:30 p. m. At Governors Island the tide was high at 10:40 a. m. and low at 5:12 p. m. The wind was north to northwest, with a minimum velocity of 4 miles per hour between noon and 1:00 p. m. and 13 miles per hour between 3:00 and 4:00 p. m.

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Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		a. m.					
51	Narrows opposite Fort Hamilton.	10:00	5	1,200	+	+	+
52	Narrows opposite Fort Hamilton.	10:10	40	270	+	+	+
53	Narrows opposite Fort Hamilton.	10:15	80	90	+	+	+
54	¾ mile north Robbins Reef.....	10:53	5	1,730	+	+	+
55	¾ mile north Robbins Reef.....	11:15	40	400	+	0	+
56	¾ mile north Robbins Reef.....	10:58	80	260	0	0	0
57	Off Battery and Governor's Island, mid stream.....	*p. m.* 2:40	at surface	3,330	0	+	+
58	Off Battery and Governor's Island, mid stream.....	2:30	5	1,540	+	+	+
59	Off Battery and Governor's Island, mid stream.....	2:35	20	1,180	+	+	+
60	Off Battery and Governor's Island, mid stream.....	2:22	40	730	+	+	+
61	Off Battery and Governor's Island, mid stream.....	2:38	60	560	0	0	0
62	Off Battery and Governor's Island, mid stream.....	2:15	80	460	+	+	+
63	¾ mile north Robbins Reef.....	3:05	5	2,160	+	+	+
64	¾ mile north Robbins Reef.....	3:57	40	380	+	+	+
65	¾ mile north Robbins Reef.....	2:45	80	260	+	+	+
66	Narrows	3:21	5	1,090	+	+	+
67	Narrows	3:24	40	810	0	+	+
68	Narrows	3:30	80	970	+	+	+

Table 2. Results of bacterial analyses of water taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 30, 1906, between 11:00 a. m. and 3:40 p. m. High water occurred at Governor's Island at 12:05 p. m. The wind was south and varied from 10 to 15 miles per hour.

Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		a. m.					
69	Narrows opposite Fort Hamilton.	11:12	5	220	+	+	+
70	Narrows opposite Fort Hamilton.	11:05	40	390	0	+	+
71	Narrows opposite Fort Hamilton.	11:00	80	350	+	+	+
72	¾ mile north Robbins Reef.....	*p. m.* 12:10	5	1,280	+	+	+
73	¾ mile north Robbins Reef.....	*m.* 12:00	40	1,055	+	+	+
74	¾ mile north Robbins Reef.....	*a. m.* 11:55	80	595	+	+	+
75	Off Battery and Governor's Island, mid stream.....	*p. m.* 12:35	5	1,510	+	+	+
76	Off Battery and Governor's Island, mid stream.....	12:30	40	920	0	+	+
77	Off Battery and Governor's Island mid stream.....	12:20	80	760	+	+	+
78	Off Battery and Governor's Island, mid stream.....	3:15	5	1,200	+	+	+
79	Off Battery and Governor's Island, mid stream.....	3:10	40	740	+	+	+
80	Off Battery and Governor's Island, mid stream.....	3:00	80	540	0	+	+
81	¾ mile north Robbins Reef.....	3:40	5	930	0	+	+
82	¾ mile north Robbins Reef.....	3:32	40	750	0	+	+
83	¾ mile north Robbins Reef.....	3:26	80	420	0	0	+

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15 Tables 1 and 2 show that the numbers of bacteria were very much larger near the surface than in the water below. The reduction in the numbers with the depth is striking and indicates that most of the sewage, and other decomposable refuse with which the bacteria were associated, was flowing around at the surface and not mixing uniformly with the water. The tests for B. coli confirm the conclusions which might be derived from a study of the numbers of bacteria alone. There were more coli at the top of the water than in the water below.

In a very large majority of all the samples examined in the commission's investigations, the presumptive tests for coli have resulted positively. In a few cases they have resulted negatively at depths of 60 feet and over.

2. Bacterial Condition of the Gowanus Canal.

One of the most polluted arms of the Upper Bay is the Gowanus Canal on the Brooklyn shore. The odors from this canal constitute such a decided nuisance to the people who live and work in its vicinity that the City of New York has recently let contracts for the construction of pumping engines and a tunnel at an expense of about $275,000 to flush out this odorous canal.

In order to obtain an accurate idea of the data which this water would yield on analysis, chemical and bacteriological examinations were made of three samples of the canal water taken from different points between the outlet and the head of the canal. The results are given in table 3.

Table 3. Results of chemical and bacterial analyses of water taken from the Gowanus Canal. The samples were taken from a boat at a depth of one foot below the surface on February 3, 1906.

16

Map No.	Point of collection of sample.	Free ammonia.	Albuminoid ammonia.	Chlorine.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
84	Head of Gowanus Canal.	24.00	5.40	1,400	1,050,000	+	+	+
85	Below Union Street.....	5.60	2.16	5,900	190,000	+	+	+
86	Near Outlet	3.40	1.26	7,450	100,000	+	+	+

According to this table, there was a decided difference between the condition of the water of the canal at different points, but in no case was it satisfactory from a sanitary standpoint. The bacteria were enormously large in number, as were the amounts of free and albuminoid ammonia present. The tests for coli resulted positively in every case.

The condition of the Gowanus Canal, as shown by this table, of Bodine Creek and of the Rahway River, as given in table 5, and of the Bronx River, as given in table 6, indicate conditions which should serve as a warning of what the whole bay may become if it is not protected against unlimited pollution in the future.

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3. Bacteria at Different Depths in the Lower Bay and Narrows.

The bacterial condition of the water of the Lower Bay and Narrows at different depths was investigated to determine whether there was any marked difference in the pollution at points below the surface as compared with the conditions at the top. The results are given in table 4.

Table 4. Results of bacterial analyses of water taken from various points at different depths in the Lower Bay and Narrows. The samples were collected from a boat on February 17, 1906, between 2:45 p. m. and 4:40 p. m. High water occurred at Sandy
17 Hook at 2:39 p. m., and at Governor's Island at 2:55 p. m. The wind was southwest to south and averaged 6½ miles per hour.

Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		p. m.					
87	Off Norton's Point, Lower Bay.	3:30	5	1,045	0	+	+
88	Off Norton's Point, Lower Bay.	3:00	40	560	0	0	+
89	Off Norton's Point, Lower Bay.	2:45	80	225	0	0	+
90	Narrows	4:40	5	1,180	0	+	+
91	Narrows	4:25	40	545	0	+	+
92	Narrows	4:10	80	460	0	+	+

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Table 4 shows that the water near the surface contained several times as many bacteria as the water near the bottom. The numbers of bacteria were not quite as large in the Lower Bay as in the Upper Bay, but the difference was slight. Not so many samples of deep water as surface water gave positive results in the coli tests.

4. Bacteria in Upper Bay and Lower Parts of the East and North Rivers.

In order to obtain further information concerning the bacterial condition of the water in the Upper Bay and lower ends of the East and North rivers, a series of examinations of these waters was made as shown in table 5.

Table 5. Results of bacterial analyses of water taken from various points in the Upper Bay and lower ends of the East and North rivers. The samples were collected from a boat on March 2, 1906, between 11:00 a. m. and 5:15 p. m. At Governors Island high tide occurred at 12:20 p. m., and low tide at 7:10 p. m. The wind was east and northeast and ranged from 5 to 9 miles per hour.

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Map No.	Point of collection of sample.	Time.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		a. m.				
93	Off Bath Beach, Brooklyn	11:00	4,100	+	+	+
94	Head of Lower Bay, off Fort Wadsworth, Narrows	11:10	3,380	+	+	+
95	Off Clifton, Staten Island, mid stream	11:15	3,100	+	+	+
96	Off Tompkinsville, Staten Island	11:25	3,580	+	+	+
97	West end of Kill von Kull	11:35	4,670	+	+	+
98	Off New Brighton, Staten Island, Kill von Kull	11:45	3,500	0	+	+
		m.				
99	Kill von Kull, off Sailors' Snug Harbor, Staten Island	12:00	3,800	0	+	+
		p. m.				
100	Kill von Kull, off Port Richmond, Staten Island	12:10	4,900	+	+	+
101	Northwest Robbins Reef Light	1:45	3,250	+	+	+
102	Northeast Robbins Reef Light	1:50	3,080	0	+	+
103	Midway between Robbins Reef and Liberty Island	1:55	3,200	+	+	+
104	Southwest of Liberty Island	1:57	5,910	+	+	+
105	Between Liberty Island and Claremont, New Jersey	2:00	6,800	+	+	+
106	Between Ellis Island and Liberty Island	2:05	5,120	0	+	+
107	Off Ellis Island	2:12	8,650	+	+	+
108	Northeast of Ellis Island	2:15	7,060	+	+	+
109	Off Central R. R. of N. J. Docks, N. J.	2:20	7,480	+	+	+
110	Off Penn. R. R. Docks, N. J.	2:30	5,100	+	+	+
111	Off Erie R. R. Docks, N. J.	2:45	5,350	+	+	+
112	Off D., L. & W. R. R. Docks, N. J.	2:55	4,300	0	+	+
113	North of Hoboken, N. J.	3:10	3,560	0	+	+
114	Off Weehawken, N. J.	3:25	3,120	0	+	+
115	Off American Line Dock, mid stream	3:35	5,410	+	+	+
116	Off Pier No. 4, North River, Manhattan	3:40	5,780	+	+	+
117	Off Battery, Manhattan	3:38	7,280	+	+	+
118	Off Pier No. 6, East River, Manhattan	3:45	14,100	+	+	+
119	Off Pier No. 13, East River, Manhattan	3:55	18,400	+	+	+
120	Off Pier No. 20, East River, Manhattan	3:58	12,600	+	+	+
121	Off Pier No. 28, East River, Manhattan	4:00	15,200	+	+	+
122	Off Pier No. 23, East River, Brooklyn	4:05	4,300	0	0	+
123	Off Atlantic Docks, Buttermilk Channel, Brooklyn	4:15	10,400	+	+	+
124	Off Beards, Erie Basin, Brooklyn	4:20	36,800	+	+	+
125	Off Gowanus Bay, Brooklyn	4:25	8,500	+	+	+
126	Off Gowanus and Hamilton ave. Bridge, Brooklyn	4:35	270,000	+	+	+
127	Between Hamilton ave. Bridge and outlet, ——, Brooklyn	4:40	180,000	+	+	+
128	Off Prince Line Dock, Brooklyn	4:50	24,300	+	+	+
129	Off 56th Street, Brooklyn	5:00	16,400	+	+	+
130	Off 65th Street, near sewer, Brooklyn	5:05	278,000	+	+	+
131	Off Crescent Club, Brooklyn	5:15	5,800	0	+	+
132	At oyster beds, mouth of Bodine Creek, Port Richmond	12:35	11,200	+	+	+
133	Bodine Creek, midway to head at crossing	12:30	11,500	+	+	+
134	Bodine Creek, upper end	12:25	15,800	+	+	+
135	Rahway river, below sewer outlet	12:30	8,500	+	+	+
136	Rahway River, N. J., over oyster beds	2:15	5,800	+	+	+

One of the most significant features of table 5 is the large proportion of positive results obtained in the tests for B. coli. Nearly every test resulted positively. The numbers of bacteria were comparatively large, in some cases decidely so. The greatest numbers were contained in samples taken within range of extensive local sources of pollution, such as the Gowanus Canal and the
19 large sewer which empties from the Brooklyn shore in the neighborhood of 65th street.

The East River contained many more bacteria than the North River or the Upper Bay—or even the Staten Island shore, which is one of the most polluted localities which have been investigated.

Samples of water were taken from Bodine Creek and the Rahway River, which latter empties into the Arthur Kill on the west side of Staten Island, in order to show the conditions of water in which oysters are extensively "drinked" in preparation for the New York market. Both streams were known from previous investigations to be decidely polluted with sewage. The conditions surrounding Bodine Creek were described in the first report of the New York Bay Pollution Commission. The Rahway River receives the sewage of the municipality of Cranford and the sewage of the city of Rahway.

The results of these examinations are given in table 5. In view of the known pollution of these two streams, it seems a little curious that the numbers of bacteria were not larger.

5. Bacterial Condition of the Lower Bronx River.

Notwithstanding the fact that some effort has been made to protect the lower part of the Bronx River against sewage pollution, the condition of that stream is far from satisfactory. Samples of water were taken at different points below the dam toward the mouth of the Bronx River with results which are given in table 6.

Table 6. Results of chemical and bacterial analyses of water taken from various points in the Bronx River at a depth of one foot below the surface. The samples were collected from a boat on March 31, 1906, between 3:00 and 4:30 p. m. High water occurred at
20 Willett's Point at 3:20 p. m. The wind was northwest and averaged 31 miles per hours. (Results stated in parts per million.)

Map No.	Point of collection of sample.	Free ammonia.	Albuminoid ammonia.	Chlorine.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	0.1 c. c.	10 c. c.
137	Bronx River, below dam	.300	.250	50	14,800	+	+	+
138	Bronx River, at mouth.	.310	.340	5,200	9,500	+	+	+
139	Bronx River, between mouth and Hunts Point	.250	.530	6,600	7,200	+	+	+
140	Bronx River, off Hunts Point	.240	.260	13,500	3,400	+	+	+

NOTE.—The following figures give the number of cubic centimeters of dissolved oxygen per litre found in these samples: No. 137, 8.62 c. c. oxygen; No. 138, 9.28 c. c. oxygen; No. 139, 7.07 c. c. oxygen; No. 140, 9.61 c. c. oxygen.

The numbers of bacteria given in this table show diminishing pollution as the river approaches its mouth. From the dam to the mouth of the river the reduction in the numbers of bacteria was decided. The differences in the amounts of free and albuminoid ammonia were not so noticeable, but there was a progressive reduction in the free ammonia which confirms the bacterial results. It is interesting to note that all of the tests for B. coli gave positive results.

6. Bacteria in the Rivers Surrounding Manhattan Island.

A series of analyses was made to determine the bacterial condition of the Hudson, East and Harlem rivers. The results of these examinations are given in table 7.

Table 7. Results of bacterial analyses of water taken from various points in the waters surrounding Manhattan Island. The samples were collected from a boat on April 1, 1906, between 9:55 a. m. and 3:05 p. m., at a depth of one foot below the surface, unless otherwise indicated. High water occurred at Governors
21 Island at 12:30 p. m. The tide was low at Governors Island at 7:16 a. m., and at Willetts Point at 10:13 a. m. The wind was northwest and ranged from 17 to 32 miles per hour.

Map No.	Point of collection of sample.	Time.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		p. m.				
141	Hudson River, opposite Spuyten Duyvil	12:42	3,550	+	+	+
142	Hudson River, north of Fort Washington Point	12:50	2,230	+	+	+
143	Hudson River, south of Fort Washington Point	1:05	2,310	+	+	+
144	Hudson River, off Grant's tomb, bottom	1:15	3,210	+	+	+
145	Hudson River, off Grant's tomb, surface	1:20	2,640	0	+	+
146	Hudson River, off West 80th Street	2:45	2,990	+	+	+
147	Hudson River, off West 40th Street	3:05	4,080	+	+	+
		a. m.				
148	East River, off Battery, bottom	9:55	4,280	+	+	+
149	East River, off Battery, surface	10:00	6,250	+	+	+
150	East River, Pier No. 15	10:05	4,410	+	+	+
151	East River, under Manhattan bridge	10:10	8,460	+	+	+
152	East River, below Blackwell's Island, bottom	10:40	8,320	+	+	+
153	East River, below Blackwell's Island, surface	10:45	8,940	+	+	+
154	East River, above Blackwell's Island	11:05	9,120	+	+	+
155	East River, off Randall's Island	11:20	8,740	+	+	+
156	Harlem River, first bridge	11:30	7,200	+	+	+
157	Harlem River, third bridge	11:35	3,640	+	+	+
158	Harlem River, fifth bridge, Madison avenue	11:40	3,290	+	+	+
159	Harlem River, seventh bridge	11:45	2,970	0	+	+
160	Harlem River, Highbridge, bottom	11:50	2,760	0	0	+
161	Harlem River, Highbridge, surface	11:55	3,530	+	+	+

Map No.	Point of collection of sample.	Time.	Bacteria per c. c.	Tests for B. Coli. 0.1 c. c.	1.0 c. c.	10 c. c.
		p. m.				
162	Harlem River, above Washington bridge	12:05	3,675	0	+	+
163	Harlem River, opposite N. Y. University	12:15	1,080	0	0	+
164	Harlem River, Broadway bridge	12:25	2,400	0	+	+
165	Harlem River, bend of river between last two bridges	12:35	2,310	0	0	0
166	Harlem River, N. Y. Central bridge.	12:40	2,340	0	0	0

Nearly all of the samples recorded in the foregoing table gave positive results in the presumptive test for B. coli. The only exception was in water from the Harlem River. The condition of the Harlem appears to have been much better than either that of the East or Hudson River, although the numbers of bacteria were in no case low, considering the season of the year when the samples were collected. The East River was decidedly more polluted than either the Hudson or Harlem. The average of the numbers of bacteria was more than twice as high in the East River as in the other two rivers.

The water near the bottom of the East River near the Battery contained about as many bacteria as the water at the surface at this point.

22 The Hudson from its junction with the Harlem to 40th street was, like the East River, decidedly polluted.

B—Results of Chemical Analyses.

1. Chemical Condition of Water from Different Depths in the Upper Bay.

Samples of water from different depths at points between the Battery and the Narrows were analyzed chemically to determine whether the evidence so obtained would show any difference in the conditions. The results are given in tables 8 and 9.

Table 8. Results of chemical analyses of water taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 28, 1906, between 10:00 a. m. and 3:30 p. m. At Governor's Island the tide was high at 10:40 a. m., and low at 5:12 p. m. The wind was north to northwest with a minimum velocity of 4 miles per hour between noon and 1:00 p. m., and 13 miles per hour between 3:00 and 4:00 p. m. (Results stated in parts per million).

Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		a. m.				
51	Narrows opposite Fort Hamilton..	10:00	5	.182	.192	10,650
52	Narrows opposite Fort Hamilton..	10:10	40	.158	.162	12,600
53	Narrows opposite Fort Hamilton..	10:15	80	.152	.160	14,000
54	⅜ mile north Robbins Reef.....	10:53	5	.196	.136	8,800
55	⅜ mile north Robbins Reef.....	11:15	40	.178	.150	12,600
56	⅜ mile north Robbins Reef.....	10:58	80	.186	.168	12,400
		p. m.				
57	Off Battery and Governor's Island, mid stream	2:40	*	....	....	9,700
58	Off Battery and Governor's Island, mid stream	2:30	5	.300	.224	10,200
59	Off Battery and Governor's Island, mid stream	2:35	20	....	....	10,900
60	Off Battery and Governor's Island, mid stream	2:22	40	.180	.164	11,700
61	Off Battery and Governor's Island, mid stream	2:28	60	....	....	12,800
62	Off Battery and Governor's Island, mid stream	2:15	80	.174	.210	12,900
63	⅜ mile north Robbins Reef.....	3:05	5	.222	.146	9,100
64	⅜ mile north Robbins Reef.....	3:57	40	.254	.142	13,100
65	⅜ mile north Robbins Reef.....	2:45	80	.160	.140	13,200
66	Narrows	3:21	5	.206	.150	9,400
67	Narrows	3:24	40	.210	.168	10,400
68	Narrows	3:30	80	.214	.230	12,800

* At surface.

23 Table 9. Results of chemical analyses of water taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 30, 1906, between 11:00 a. m. and 3:40 p. m. High water occurred at Governor's Island at 12:05 p. m. The wind was south and varied from 10 to 15 miles per hour. (Results stated in parts per million).

Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		a. m.				
69	Narrows opposite Fort Hamilton..	11:12	5	.186	.126	10,900
70	Narrows opposite Fort Hamilton..	11:05	40	.144	.126	13,700
71	Narrows opposite Fort Hamilton..	11:00	80	....	....	14,500
		p. m.				
72	⅝ mile north Robbins Reef.....	12:10	5	.204	.134	10,500
		m.				
73	⅝ mile north Robbins Reef.....	12:09	40	.186	.156	11,700
		a. m.				
74	⅝ mile north Robbins Reef.....	11:55	80	.156	.174	12,800
		p. m.				
75	Off Battery and Governor's Island, mid stream	12:35	5	.194	.156	7,600
76	Off Battery and Governor's Island, mid stream	12:30	40	.198	.146	11,600
77	Off Battery and Governor's Island, mid stream	12:20	80	.150	.146	12,700
78	Off Battery and Governor's Island, mid stream	3:15	5	.220	.146	9,100
79	Off Battery and Governor's Island, mid stream	3:10	40	.140	.134	13,100
80	Off Battery and Governor's Island, mid stream	3:00	80	.142	.144	13,200
81	⅝ mile north Robbins Reef.....	3:40	5	.190	.134	10,400
82	⅝ mile north Robbins Reef.....	3:32	40	.156	.146	12,400
83	⅝ mile north Robbins Reef.....	3:26	80	.154	.152	12,500

The analyses recorded in these two tables show that there was a reduction in the amount of albuminoid and free ammonia in the water as the depth from the surface increased. In some cases this difference was very decided; in others it was less marked. An average of all the results indicates that the water near the surface was much more polluted than the water below.

It is interesting to observe in this table that the chlorine invariably increased with the depth, showing that there was a larger percentage of sea water at the bottom than at the surface. Reasons for believing that this was the case were given in the first report of the New York Bay Pollution Commission.

2. Chemical Condition of the Water at Different Depths in the Lower Bay and Narrows.

In order to show the difference in the amount of pollution which might exist in the water at different depths in the Lower Bay, a series of samples was collected near Coney Island and the Narrows. The results are given in table 10.

Table 10. Results of chemical analyses of water taken at various points at different depths in the Lower Bay and Narrows. The samples were collected from a boat on February 17, 1906, between 2:45 and 4:40 p. m. High water occurred at Sandy Hook at 2:39 p. m., and at Governor's Island at 2:55 p. m. The wind was southwest to south and averaged 6½ miles per hour. (Results stated in parts per million.)

Map No.	Point of collection of sample.	Time.	Depth below surface in feet.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		p. m.				
87	Off Norton's Point, Lower Bay....	3:30	5	.250	.275	12,500
88	Off Norton's Point, Lower Bay....	3:00	40	.280	.180	15,300
89	Off Norton's Point, Lower Bay....	2:45	80	.250	.280	15,500
90	Narrows	4:40	5	.260	.200	12,800
91	Narrows	4:25	40	.130	.130	14,400
92	Narrows	4:10	80	.275	.275	14,800

Table 10 shows that the extent of the pollution did not, in this case, vary inversely as to depth. There were larger amounts of free and albuminoid ammonia near the surface and at the bottom than in the middle. These differences were marked. It appeared that a stratum of water containing more sewage than was found in the Upper Bay lay at the top and bottom, while the water between was in a somewhat less contaminated condition.

The chlorine results show that the water was considerably salter at the bottom than at the top.

These chemical conditions formed an exception to the rule which had been observed thus far, that is, that there was more sewage at the surface than below.

3. Chemical Condition of Water of New York Bay and Lower Ends of East and North Rivers.

Samples of water were taken at different points in the vicinity of the Upper Bay and analyzed chemically with the results given in table 11.

Table 11. Results of chemical analyses of water taken from various points in the Upper Bay and lower ends of the East and North rivers. The samples were collected from a boat on March 2, 1906, between 11:00 a. m. and 5:15 p. m. At Governors Island high water occurred at 12:20 p. m., and low water at 7:10 p. m. The wind was east and northeast and ranged from 5 to 9 miles per hour. (Results stated in parts per million.)

Map No.	Point of collection of sample.	Time.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		a. m.			
95	Off Ruth Beach, Brooklyn	11:00	.....	.....	10,000
96	Head of Lower Bay, off Fort Wadsworth Narrows	11:10	.....	.....	9,000
97	Off Clifton, Staten Island, mid stream	11:15	.....	.....	6,700
98	Off Tompkinsville, Staten Island	11:25	.300	.200	6,500
97	West end of Kill von Kull	11:25	.380	.200	7,100
99	Off New Brighton, Staten Island, Kill von Kull	11:45	.....	.....	7,000
99	Kill von Kull off Sailors Snug Harbor, Staten Island	12:00 m.	.....	.....	7,100
100	Kill von Kull, off Fort Richmond, Staten Island	12:10 p. m.	.270	.250	7,000
101	Northwest Robbins Reef Light	1:45	.340	.210	6,000
102	Northeast Robbins Reef Light	1:50	.....	.....	6,300
103	Midway between Robbins Reef and Liberty Island	1:55	.....	.....	6,900
104	Southwest of Liberty Island	1:57	.340	.190	5,300
105	Between Liberty Island and Claremont, N. J.	2:00	.....	.....	5,700
106	Between Ellis Island and Liberty Island	2:05	.....	.....	6,000
107	Off Ellis Island	2:12	.....	.....	5,700
108	Northeast of Ellis Island	2:15	.370	.220	6,000
109	Off C. R. R. of N. J. Docks, N. J.	2:20	.400	.210	6,700
110	Off Penn. R. R. Docks, N. J.	2:30	.....	.....	6,200
111	Off Erie R. R. Docks, N. J.	2:45	.....	.....	6,000
112	Off D., L. & W. R. R. Docks, N. J.	2:55	.330	.240	5,200
113	North of Hoboken, N. J.	3:10	.....	.....	5,100
114	Off Weehawken, N. J.	3:25	.330	.200	4,900
78		p. m.			
115	Off American Line Dock, mid stream	3:25	.....	.....	7,000
116	Off Pier No. 4, North River, Manhattan	3:40	.....	.....	7,500
117	Off Battery, Manhattan	3:50	.300	.280	8,200
118	Off Pier No. 6, East River, Manhattan	3:45	.....	.....	8,400
119	Off Pier No. 13, East River, Manhattan	3:55	.410	.240	8,600
120	Off Pier No. 20, East River, Manhattan	3:58	.370	.230	8,800
121	Off Pier No. 28, East River, Manhattan	4:00	.520	.490	8,400
122	Off Pier No. 23, East River, Brooklyn	4:05	.....	.....	8,600
123	Off Atlantic Docks, Buttermilk Channel, Brooklyn	4:15	.400	.250	8,600
124	Off Beards, Erie Basin, Brooklyn	4:20	.....	.....	8,600
125	Off Gowanus Bay, Brooklyn	4:25	.740	.350	8,600
126	Off Gowanus and Hamilton ave. bridge, Brooklyn	4:35	7.000	1.110	6,800
127	Between Hamilton ave. bridge and outlet, Brooklyn	4:40	.....	.....	8,500
128	Off Prince Line Dock, Brooklyn	4:50	.....	.....	8,400
129	Off 50th street, Brooklyn	5:00	.....	.....	7,900
130	Off 65th st., near sewer, Brooklyn	5:05	3.700	1.430	6,500
131	Off Crescent Club, Brooklyn	5:15	.....	.....	8,000
132	At oyster beds mouth of Bodine Creek, Port Richmond	12:25	.465	.260	5,000
133	Bodine Creek, midway to head at crossing	12:30	.400	.240	2,000
134	Bodine Creek, upper end	12:25	.330	.280	490
135	Rahway River, N. J., below sewer outlet	12:30	.280	.320	6
136	Rahway River, N. J., over oyster beds	2:15	.270	.310	240

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On the occasion when the samples were collected for table 11, there was a larger amount of sewage in the water than had been observed previously. Some of the samples, although not collected near obvious sources of pollution, contained relatively large amounts of free ammonia. The water in the lower end of the East River was notable in this respect.

4. Chemical Condition of the Waters of the Rivers Surrounding Manhattan Island.

Samples of water taken from the East River, Harlem River and Hudson River were analyzed chemically with the results given in table 12.

Table 12. Results of chemical analyses of water taken from various points in the waters surrounding Manhattan Island. The samples were collected from a boat at a depth of one foot below the surface, unless otherwise indicated, on April 1, 1906, between 9:55 a. m. and 3:05 p. m. High water occurred at Governors Island at 12:30 p. m. The tide was low at Governor's Island at 7:16 a. m. and at Willetts Point at 10:13 a. m. The wind was northwest and ranged from 17 to 32 miles per hour. (Results stated in parts per million.)

Map No.	Point of collection of sample.	Time.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		p. m.			
141	Hudson River, opposite Spuyten Duyvil.	12:42	.150	.220	290
142	Hudson River, north of Fort Washington Point	12:50	.190	.210	250
143	Hudson River, south of Fort Washington Point	1:05	.150	.190	810
144	Hudson River, off Grant's tomb, bottom	1:15	.250	.240	7,700
145	Hudson River, off Grant's tomb, surface	1:20	.230	.300	510
146	Hudson River, off West 80th street	2:45	.170	.250	990
147	Hudson River, off West 40th street	3:05	.260	.250	1,150
		a. m.			
148	East River, off Battery, bottom	9:55	.310	.270	11,800
149	East River, off Battery, surface	10:00	.320	.270	6,100
150	East River, off Pier No. 15	10:05	.....	.....	4,800
151	East River, under Manhattan bridge	10:10	.490	.320	9,600
152	East River, below Blackwell's Island, bottom	10:40	.380	.290	11,900
153	East River, below Blackwell's Island, surface	10:45	.500	.360	10,900
154	East River, above Blackwell's Island	11:05	.360	.370	12,300
155	East River, off Randall's Island	11:20	.870	.720	10,900
156	Harlem River, first bridge	11:30	.410	.450	8,700
157	Harlem River, third bridge	11:35	.....	.....	7,800
158	Harlem River, fifth bridge, Madison ave.	11:40	.330	.320	7,100
159	Harlem River, seventh bridge	11:45	.....	.....	4,300
160	Harlem River, Highbridge, bottom	11:50	.170	.220	1,400
161	Harlem River, Highbridge, surface	11:55	.270	.250	1,300

Map No.	Point of collection of sample.	Time.	Free ammonia.	Albuminoid ammonia.	Chlorine.
		p. m.			
162	Harlem River, above Washington bridge	12:05	.....	.....	900
163	Harlem River, opposite N. Y. University	12:15	.....	.....	800
164	Harlem River, Broadway bridge	12:25	.140	.230	650
165	Harlem River, bend of river between last two bridges	12:35	.....	.....	600
166	Harlem River, N. Y. Central bridge	12:40	.250	.170	600

The water of the East River contained, on an average, more free and albuminoid ammonia than the waters of the Hudson or Harlem rivers. It was, therefore, decidedly more polluted.

There was little difference between the water at the surface and at the bottom, so far as the ammonias indicated.

There was much more sea water in the East River than in the Hudson or Harlem rivers.

The condition of the Harlem River, as indicated by these analyses, was not far different from that of the Hudson.

The results of the determinations of chlorine show that the Hudson River was comparatively fresh as far south as the middle of Manhattan Island, except at the bottom. There was much more salt water near the bottom than at the top. A sample collected near the bottom, off Grant's Tomb, contained about thirteen times as much chlorine as the average of the surface samples above 40th street.

Off the Battery there was nearly twice as much sea water at the bottom as at the top.

There was a steady decrease in the amount of salt water in the Harlem River from the East River to the Hudson.

4. Amount of Oxygen Found in the Waters of New York Bay and Vicinity.

Inasmuch as the digestion of sewage in the tidal waters about New York depends largely upon their supply of oxygen, a series of analyses was made to determine whether these waters contained as much oxygen as they should have. Tables 13, 14 and 15 give the results of the oxygen determinations at different depths in the waters of the Upper and Lower bays.

Table 13. Results of analyses of water for oxygen taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 28, 1906, between 10:00 a. m. and 3:30 p. m. At Governors Island the tide was high at 10:40 a. m., and low at 5:12 p. m. The wind was north to northwest with a minimum velocity of 4 miles per hour, between noon and 1:00 p. m., and 13 miles per hour between 3:00 and 4:00 p. m. (Results stated in cubic centimeters of oxygen per litre of water.)

Map. No.	Point of collection of sample.	Time.	Depth below surface in feet.	Oxygen.
		a. m.		
51	Narrows opposite Fort Hamilton	10:00	5	6.49
51	Narrows opposite Fort Hamilton	10:10	40	7.14
53	Narrows opposite Fort Hamilton	10:15	80	6.27
54	¾ mile north Robbins Reef	10:53	5	7.45
		p. m.		
58	Off Battery and Governor's Island, mid stream	2:30	5	7.24
63	¾ mile north Robbins Reef	3:05	5	7.68
65	¾ mile north Robbins Reef	2:45	80	7.15
66	Narrows	3:21	5	7.47

29 Table 14. Results of analyses of water for oxygen taken from various points at different depths in Upper New York Bay. The samples were collected from a boat on January 30, 1906, between 11:00 a. m. and 3:40 p. m. High water occurred at Governors Island at 12:05 p. m. The wind was south and varied from 10 to 15 miles per hour. (Results stated in cubic centimeters of oxygen per litre of water.)

Map. No.	Point of collection of sample.	Time.	Depth below surface in feet.	Oxygen.
		a. m.		
69	Narrows opposite Fort Hamilton	11:12	5	8.82
70	Narrows opposite Fort Hamilton	11:05	40	7.31
71	Narrows opposite Fort Hamilton	11:00	80	7.16
		p. m.		
72	¾ mile north Robbins Reef	12:10	5	9.19
		p. m.		
75	Off Battery and Governor's Island, mid stream	12:35	5	8.51
78	Off Battery and Governor's Island, mid stream	3:15	5	8.63
81	¾ mile north Robbins Reef	3:40	5	7.38

Table 15. Results of analyses of water for oxygen taken from various points at different depths in the Lower Bay and Narrows. The samples were collected from a boat on February 17, 1906, between 2:45 p. m. and 4:40 p. m. High water occurred at Sandy Hook at 2:39 p. m., and at Governors Island at 2:55 p. m. The wind was southwest to south and averaged 6½ miles per hour. (Results stated in cubic centimeters of oxygen per litre of water.)

Map. No.	Point of collection of sample.	Time.	Depth below surface in feet.	Oxygen.
		p. m.		
87	Off Norton's Point, lower bay	3:30	5	7.16
88	Off Norton's Point, lower bay	3:00	40	7.46
89	Off Norton's Point, lower bay	2:45	80	8.13
90	Narrows	4:40	5	6.71
91	Narrows	4:25	40	7.68
92	Narrows	4:10	80	6.86

30 The three foregoing tables show that there was always enough oxygen in the water to insure a sufficient supply for the bacteria of decomposition. Under such circumstance no offensive odors would be formed by them.

In many cases the amount of oxygen increased with the depth. Samples taken near the surface usually did not have as much oxygen as samples from below. This was contrary to what might have been expected and seems to show that the disproportionately large numbers of bacteria of decomposition which exist near the surface consume enough of the oxygen to visibly reduce its amount.

Oxygen determinations were also made of samples of water collected at the surface at a number of other points in the vicinity of New York. The results are given in tables 16 and 17.

Table 16. Results of analyses of water for oxygen taken from various points in the Upper Bay and lower ends of the East and North rivers. The samples were collected from a boat on March 2, 1906, between 11:25 a. m. and 5:05 p. m. At Governors Island high water occurred at 12:20 p. m., and low water at 7:10 p. m. The wind was east and northeast and ranged from 5 to 9 miles per hour. (Results stated in cubic centimeters of oxygen per litre of water.)

Map No.	Point of collection of sample.	Time.	Oxygen.
		a. m.	
96	Off Tompkinsville, Staten Island	11:25	7.94
97	West end of Kill von Kull	11:35	7.52
		p. m.	
100	Kill von Kull, off Port Richmond, Staten Island	12:10	6.69
107	Off Ellis Island	2:12	6.79
113	North of Hoboken, N. J.	3:10	7.61
114	Off Weehawken, N. J.	3:25	7.62
121	Off Pier No. 28, East River, Manhattan	4:00	6.98
123	Off Atlantic Docks, Buttermilk Channel, Brooklyn	4:15	6.54
125	Off Gowanus Bay, Brooklyn	4:25	5.63
126	Off Gowanus and Hamilton ave. bridge, Brooklyn	4:35	.00
130	Off 65th st., near sewer, Brooklyn	5:05	4.86
134	Bodine Creek, upper end	12:25	7.50

31 Table 17. Results of analyses of water for oxygen taken from various points in the waters surrounding Manhattan Island. The samples were collected from a boat on April 1, 1906, between 9:55 a. m. and 1:15 p. m. High water occurred at Governors Island at 12:30 p. m. The tide was low at Governors Island at 7:16 a. m., and at Willett's Point at 10:13 a. m. The wind was

Map No.	Point of collection of sample.	Time.	Oxygen.
		p. m.	
144	Hudson River, off Grant's tomb, bottom	1:15	8.80
145	Hudson River, off Grant's tomb, surface	1:20	9.15
		a. m.	
148	East River, off Battery, bottom	9:55	8.62
149	East River, off Battery, surface	10:00	8.84
152	East River, below Blackwell's Island, bottom	10:40	8.29
153	East River, below Blackwell's Island, surface	10:45	8.07

northwest and ranged from 17 to 32 miles per hour. (Results stated in cubic centimeters of oxygen per litre of water.)

It will be observed that the oxygen was exhausted in only one of the samples examined, that is, in that one which was collected from the Gowanus Canal. There was a decided reduction below the average in the amount of oxygen in the water of the bay opposite the outlet of the Gowanus Canal and also near the outfall of the large trunk sewer at 65th street, Brooklyn. This showed the effect of sewage contamination.

In samples collected in the Hudson River and East River there was no deficiency of oxygen.

The difference between the oxygen at the bottom and near the surface of the water was noticeable in the Hudson off Grant's Tomb. Here there was more oxygen at the surface than at the bottom.

32 C—Results of a Sanitary Inspection of the Shores of New York Bay.

An inspection of the shores of New York Bay was undertaken in the latter part of March and continued until the middle of April, 1906. The object of this inspection was to observe such sewage or other pollution as might exist on or near the shores. A sanitary inspector, Dr. Payne B. Parsons, walked along the shore line and made note of sewage and refuse on the shores and in the water within his range of view.

The conditions found are given in the following tables.

Table 18. Results of a sanitary inspection of the Staten Island shore of New York bay.

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906. Mar. 27	a. m. 10:15	Midland Beach	S. W.	Ebb	Driftwood (large amount), tin cans, bottles, crockery, bones, shoes, rags, paper, shells, vegetables, dead animals, straw and fibrous material, seaweed, etc. Offensive odor.
Mar. 27	11:30	South Beach, about 100 yards of lower part.	S. W.	Ebb	In 400 square feet of shore about 1-20 cubic yard of vegetable matter, 1-20 cubic yard of animal matter and 1-2 cubic yard wood.
Mar. 27	p. m. 2:00	South Beach to Fort Wadsworth.	S.	Ebb	In 400 sq. ft. of shore about 1-30 cu. yd. of vegetable matter, 1-30 cu. yd. of animal matter and 1-2 cu. yd. of driftwood.
Mar. 28	a. m. 9:30	From upper (northern) limit of Fort Wadsworth north 100 yds.	N. W.	Flood.	Large amount of driftwood. Much less general refuse than at South Beach. Very little garbage. Two dead animals.
Mar. 28	10:00	Last point to foot of Cliff street, Rosebank.	N. W.	Flood.	Much driftwood, bottles, rags, cans, etc. Not much garbage.
Mar. 28	10:40	Foot of Cliff street to foot Pennsylvania ave., Rosebank.	N. W.	Ebb	Same as preceding.
Mar. 28	11:20	South of Doyle's wharf, about 200 yds. north of Pennsylvania ave.	N.	Ebb	Not much driftwood or garbage. Considerable amount of grease floating in water. Water polluted with a considerable amount of sewage. Nearest sewer foot West street, 100 yds. away. Did not appear from tide and wind to come from this.
Mar. 28	p. m. 12:05	Foot West st., Clifton	N. W.	Ebb	Much driftwood. Not much garbage. Surface of water covered with petroleum. Large sewer outlet here did not appear to change appearance of water. Odor very offensive from number of small sewers opening at side of street, 100 ft. from the shore. In 400 sq. ft. about 1-2 cu. yd. vegetable and 1-10 cu. yd. animal. No driftwood.
Mar. 29	a. m. 9:15	Foot of Dock st., Stapleton.	N.	Flood.	Grease and petroleum floating near shore. Driftwood, garbage, mattresses, house sweepings and formed fecal matter, the latter breaking up as it was observed, indicating that the sewage mostly came from sewer emptying at foot of street.
Mar. 29	10:00	Foot of Thompson st.	N.	Flood.	Same as preceding. Sewer emptied here. Sewage probably from this sewer.
Mar. 29	10:20	Foot of Canal st.	N. W.	Flood.	Several small sewers located here. Same conditions as above.
Mar. 29	10:40	Foot of Water st.	N. W.	Ebb	Two large sewers near together. Water covered with grease and sewage. Shore covered with sewage and general refuse. Formed feces in water and on shore. Great quantity of street sweepings and refuse from grain mill nearby. Odor offensive. Worst place found so far. No driftwood. In 400 sq. ft. of shore 1 cu. yd. vegetable matter and 1-10 cu. yd. animal matter.

Table 18.—*(Concluded.)*

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906	a. m.				
Mar. 29	11:30	Foot of Prospect st.....	N.....	Ebb...	Pier being made by dumping; some refuse falling over sides. Large sewer here, also. In 400 sq. ft. of shore about 1-5 cu. yd. vegetable, and 1-10 cu. yd. animal matter. Hardly any driftwood.
Mar. 29	m. 12:00	Foot of Wave st.....	N.....	Ebb...	Shore much cleaner. Some petroleum and grease on water.
Mar. 29	p. m. 12:15	Williams' lumber yard..	N. W..	Ebb...	Scum of grease, straw and wood about docks; large sewer. Water contains sewage, including formed feces. On shore, in 400 sq. ft., about 1-5 cu. yd. vegetable and 1-10 cu. yd. animal matter.
Mar. 29	1:30	Foot of Marietta st., Tompkinsville.	N. W..	Ebb...	Very large sewer. Water contains sewage near shore. In 400 sq. ft., about 1-5 cu. yd. vegetable and 1-10 cu. yd. animal matter; all this from sewer, apparently.
Mar. 29	2:15	Docks of Amer. Dock Stores, Tompkinsville	N. W..	Ebb...	Along docks saw some sewage, trace of garbage, fibrous matter and wood.
Mar. 29	3:00	Foot of South st., St. George.....	N. W..	Ebb...	Kerosene on water, also wood, fibre and some garbage.
Mar. 30	a. m. 9:20	Ferry Docks, St. George.	E.....	Flood.	Scum of grease and kerosene, fibrous material, garbage, wood, etc., floating about the docks. No odor. No sewage noticed.
Mar. 31	9:20	B. & O. Docks, St. George.	N. W..	Flood.	Petroleum, wood, straw and some garbage along docks.
Mar. 31	9:50	Foot Church st., New Brighton.	N. W..	Flood.	Petroleum and some driftwood.
Mar. 31	10:20	Foot Westervelt ave., New Brighton.	N.....	Flood.	Sewer here. Sewage from this, also petroleum. Some garbage and wood in water. Estimated 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter in 400 sq. ft. Two sewers here. Sewage on shore and in water from this sewer.
Mar. 31	11:30	Foot Tyson st., New Brighton.	N.....	Ebb...	Sewer here. Shore same as Lafayette st.
Mar. 31	11:50	Snug Harbor Dock....	N.....	Ebb...	Petroleum from Bayonne shore along dock. Some garbage and wood.
Mar. 31	p. m. 12:10	Between Snug Harbor and Livingston.	N. W..	Ebb...	Large open sewer empties into inlet. Shore of inlet lined with sewage, garbage, rags, paper and wood. 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter in 400 sq. ft.
Mar. 31	12:30	Club house Dock, Richmond Terrace.	N. W..	Ebb...	Petroleum and wood. No sewage.
Mar. 31	1:50	Foot Tompkins place, West New Brighton. Inlet from Tompkins place to Duncan st.	N. W..	Ebb...	Sewers open into inlet made by new railroad filling. Shore and water of inlet filthy. Odor offensive. ½ cu. yd. vegetable and 1-20 cu. yd. animal matter in 400 sq. ft.
Mar. 31	2:35	Bodine Creek, Port Richmond, near corner Richmond Terrace and Jewett ave.	N. W..	Ebb...	Shores of brook full of sewage. Many sewers empty into it. Garbage on shore. Odor offensive. Water full of sewage. Scum of grease and petroleum. Drinking ground for oysters. 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter on shore in 400 cu. ft.
Mar. 31	3:40	Port Richmond ave., Port Richmond, Bergen Beach ferry docks.	N. W..	Ebb...	Petroleum. Some garbage, wood, straw, etc. No sewage noticed.

This table shows that the Staten Island shore accumulates considerable quantities of refuse which is carried to it by the tide. Some portions of the shore are decidedly foul with sewage which is discharged by sewers from Staten Island itself.

Table 19. Results of a sanitary inspection of the New Jersey shore of New York bay.

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	a. m.				
Apr. 2	9:50	Bergen Point, Bayonne.	N. W..	Flood.	Some wood. No garbage or sewage.
Apr. 2	10:20	Foot of Hobart ave., Bayonne.	N. W..	Flood.	Rocky shore. No garbage or sewage.
Apr 2.	11:10	East end of Standard oil tanks, Bayonne	N. W..	Flood.	Petroleum on water and shore, wood. Two dead animals. About 1-30 cu. yd. vegetable and 1-40 cu. yd. animal matter in 400 sq. ft. of shore.
Apr. 2	11:35	Bayonne Yacht Club....	N. W..	Flood.	Rocky shore. No sewage or garbage. Petroleum on water.
Apr. 2	p. m. 1:05	Shore near Bayonne station, Lehigh Valley Railroad.	N. W..	Flood.	Two sewers here, 4 ft. in diameter each. Water discolored with sewage within radius of 100 yds. Also petroleum on water. Some wood and garbage, pipes, rags, etc. on shore. About 1-40 cu. yd. vegetable and 1-80 cu. yd. animal in 400 sq. ft. of shore.
Apr. 2	2:10	Foot 46th st., Bayonne.	N. W..	Ebb...	Shore free from garbage. No sewage noticed. Some wood and petroleum on water.
Apr. 3	a. m. 9:40	Foot East 49th st., Bayonne.	N. W..	Flood.	Large brick sewer here ending at high water mark. Sewage flows over beach, tide being low. Some refuse on shore. In 400 sq. ft. of shore, 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter. Odor 500 ft. leeward.
Apr. 3	10:20	Midway between 49th st. and Penn. Railroad wharf.	N. W..	Flood.	No trace of sewage. Some refuse In 400 sq. ft. of shore, about 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter.
Apr. 3	11:10	Penn. Railroad freight ferry house at end of point.	N. W..	Flood.	Scum of sewage on water from large sewer nearby. Some garbage and wood in water about dock.
Apr. 3	11:30	Penn. Railroad wharf...	N. W..	Flood.	A 5 ft. iron sewer runs out nearly to end of point on north side parallel to shore. Sewage from this sewer on shore and in water toward end of wharf. Odor not offensive on wharf.
Apr. 3	12:10	Shore opposite Bay View Cemetery, Greenview.	N. W..	Flood.	Large sewer (4 ft. iron) empties here. Runs over flats (swampy); could not reach end of it at shore.
Apr. 3	a. m. 12:20	Cavan's Point.....	N. W..	Flood.	No odor at railroad tracks. Cavan's Point shore free from garbage and sewage as far as could be seen.
Apr. 3	1:40	End of National docks, Point nearest Liberty Island.	N. W..	Flood.	Some driftwood along dock. No garbage; no sewage.

Table 19.—(*Concluded.*)

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906. Apr. 3	p. m. 2.15	Shore of Point opposite Ellis Island.	N. W.	Flood.	Some garbage, driftwood and petroleum on surface of water. In 400 sq. ft. of shore 1-30 cu. yd. vegetable and 1-60 cu. yd. animal matter.
Apr. 3	3.20	Shore between National docks and Communipaw.	W.	Ebb.	Garbage, paper and wood along docks. No sewage found.
Apr. 4	a. m. 9.25	Foot of Communipaw ave.	S. W.	Ebb.	Small sewer. Scum of grease on water. Sewage on shore. Odor had 200 ft. to leeward. No garbage.
Apr. 4	9.50	200 yds. north of Communipaw ave., along shore.	S. W.	Ebb.	A 2 ft. iron pipe empties between flats 100 ft. from shore. Runs from dredger 1 mile away, 150 yds. west of Ellis Island. Pipe discharges from free end and from cracks, sewage with coal from bottom of bay. Sewage has offensive odor. Whitish, greasy.
Apr. 4	11.05	Shore opposite Ellis Island, Jersey City.	S. W.	Flood.	Scum of grease on surface of water. Sewage on shore apparently stirred up by dredging near nearby.
Apr. 4	p. m. 12.10	Shore beside North River Coal Co. wharf, Jersey City.	S. W.	Flood.	Scum of grease on water. Odor of sewage 50 ft. to leeward. No garbage. Hardly any sewage on shore.
Apr. 4	1.45	Freight docks Central Railroad of New Jersey, Jersey City.	S. W.	Flood.	Scum of sewage on surface of water. Some garbage, wood and paper floating about dock. Some petroleum. No odor noticeable.

The New Jersey shore of the Upper New York Bay was, on the whole, comparatively free from visible traces of sewage except in the neighborhood of the outfalls of local sewers.

Table 20. Results of a sanitary inspection of the Brooklyn shore of New York Bay.

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906. Apr. 5	a. m. 9.10	Fulton Ferry dock.....	N. W.	Ebb...	Scum on surface of water in slip due to sewage. Some wood, garbage, paper and flies.
Apr. 5	9.25	N. Y. Dock Co., Rear of warehouse No. 35.	N. W.	Ebb...	Scum of grease on water; garbage, wood flies. No odor noticeable.
Apr. 5	9.50	N. Y. Dock Co., Rear of warehouse No. 30.	N. W.	Ebb...	Petroleum on surface. Odor plain.
Apr. 5	10.15	N. Y. Dock Co., West side Red D line pier.	N. W.	Ebb...	Large quantity of sewage in water. Water discolored. Scum of grease on surface. Odor 50 ft. to leeward. Paper, rags, wood, straw and garbage. Human feces noted in water.
Apr. 5	10.35	Wall st. ferry, Brooklyn.	N. W.	Ebb...	Some straw and garbage in slips.
Apr. 5	10.55	N. Y. Dock Co., between piers Nos. 13 and 14.	N. W.	Ebb...	Petroleum on surface. Odor plain.
Apr. 5	11.10	Between piers Nos. 16 and 17	N. W.	Ebb...	Large quantity of wood and flies, also garbage, bottles and paper.

Table 20.—(*Continued.*)

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1905.	a. m.				
Apr. 5	11:20	Between piers Nos. 17 and 18.	S.W..	Flood.	Same as between piers Nos. 16 and 17.
Apr. 5	11:35	West side of pier No. 19.	S.W..	Flood.	Scum of sewage on surface. Odor not bad. Wood straw, paper and garbage.
Apr. 5	11:50	Atlantic ave. ferry, Brooklyn.	S.W..	Flood.	Scum of sewage on surface. Wood, straw, papers. Odor carried 40 ft. leeward.
Apr. 5	p. m. 12:15	East side grain elevator, N. Y. Dock Co.	S.W..	Flood.	Scum of sewage on surface. Large quantity of grain refuse in water. Wood and flour, some petroleum.
Apr. 5	1:10	Foot of Amity st.....	S.W..	Flood.	Large quantity of wood. Sewage on surface. Odor 50 ft. leeward; garbage, bottles, grain. In 400 sq. ft. of shore; vegetable matter 2 cu. yds., including wood, animal matter 1-40 cu. yd.
Apr. 5	1:25	Between piers Nos. 35 and 36. Foot Congress st.	S.W..	Flood.	Scum of sewage along dock. Some petroleum.
Apr. 5	1:50	Foot of Baltic st., opposite Governor's Island.	S.W..	Flood.	Sewage in water; water discolored. Scum of grease on surface. Odor 75 ft. leeward. Some wood.
Apr. 5	2:10	Foot Sedgwick st. or street end of slip.	W.....	Flood.	Scum of sewage on surface. Some wood and garbage.
Apr. 5	3:05	At end of pier opposite center of Governor's Island.	W.....	Flood.	No sewage or garbage seen on surface.
Apr. 5	3:35	Foot of DeGraw st.....	W.....	Flood.	Large amount of sewage in water. Water discolored with it. Odor 30 ft. to leeward. Scum of grease on surface.
Apr. 5	3:50	Foot of Hamilton ave., just west of ferry house.	W.....	Flood.	Scum of sewage on surface. Odor of sewage noticeable. Sewer empties here. Wood and paper, dead fish, tin cans and garbage.
Apr. 5	4:20	Hamilton ave. ferry slips.	S.W..	Flood.	Scum of sewage on water. Garbage, wood and paper in water.
Apr. 6	a. m. 9:10	Atlantic basin. Wharf foot Summit st.	N.W..	Ebb...	Large quantity of wood, also garbage, paper and bottles. Scum of sewage on surface.
Apr. 6	9:25	Between piers Nos. 34 and 35 and between pier No. 35 and warehouse.	N.W..	Ebb...	Same as above. Odor of sewage noticeable 40 ft. to leeward.
Apr. 6	9:35	Atlantic basin wharf in rear of bonded warehouses. N. Y. Dock Co.	N.W..	Ebb...	Good deal of driftwood. Some garbage. Scum of sewage on surface in spots. Odor not apparent, except nearby.
Apr. 6	10:00	West side of Atlantic basin.	N.W..	Ebb...	Some wood and garbage. Very little evidence of sewage.
Apr. 6	10:20	Foot of Jewett st.	N.W..	Ebb...	Some wood and garbage in water about docks. No sewage found.
Apr. 6	10:45	Foot of Ithaman st.....	N.W..	Ebb...	Some wood and garbage. Water discolored with sewage to slight extent. Scum of grease on surface.
Apr. 6	11:30	West of pier No. 29....	N.W..	Ebb...	Large quantity of driftwood, also rags, paper and garbage. No sewage seen.
Apr. 6	11:50	Foot of Conover st.....	N.W..	Ebb...	Water discolored with sewage. Scum of grease on surface. No sewer here. Dead dog, wood and garbage on shore. In 400 sq. ft. of shore 1-30 sq. yd. vegetable and 1-30 sq. yd. animal matter.
Apr. 6	p. m. 1:10	Erie Basin, north end, nearest Beard st.	N.W..	Flood.	Scum of sewage on surface. Odor not noticeable. Driftwood.
Apr. 6	1:25	Foot of Richards st., Erie basin.	N.W..	Flood.	Scum of sewage on water. Some wood, garbage, cotton and fibrous material in water.

Table 20.—*Continued.*

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	p. m.				
Apr. 6	2:05	Erie basin, between Richards and Dwight sts.	N. W.	Flood	Large quantity of machine oil on surface of water from machine shops nearby. Sawdust and many small dead fish floating on surface of water.
Apr. 6	2:15	South end of Erie basin	N. W.	Flood	Good deal of driftwood on surface of water. No sewage.
Apr. 9	a. m. 9:25	Wharf between Erie basin and Gowanus bay.	N.	Ebb	Scum of sewage on surface of water on both sides of wharf. Some garbage and wood. No odor.
Apr. 9	9:30	Brooklyn basin, near entrance to Gowanus bay.	N.	Ebb	Scum of sewage on surface; wood and garbage. No odor.
Apr. 9	10:20	Inner shore of Brooklyn basin.	N.	Ebb	Scum of sewage on surface; wood and garbage. No odor.
Apr. 10	9:18	Off Gowanus bay on course of 39th st. ferry.	S. W.	Ebb	Scum of sewage on water. Some driftwood and garbage.
Apr. 10	9:25	Ferry slip, foot 39th st., Brooklyn.	W.	Ebb	Scum of sewage on water. No odor.
Apr. 10	9:30	Foot of 42nd street	W.	Ebb	Scum of sewage on water. Straw, paper, rags, garbage and feces. Water discolored with sewage. No odor.
Apr. 10	10:05	Foot 43d st.	W.	Ebb	Same as at 42nd st.
Apr. 10	10:20	Between piers Nos. 4 and 5. Bush docks. Between pier 2 and 4.	S. W.	Ebb	Scum of sewage. Salmon cans and wrappers in water.
Apr. 10	10:30	West of Bush docks. Shore foot 51st st.	S. W.	Ebb	Large quantity of sewage—scum on surface. Water discolored. Odor 50 ft. to leeward. In 600 sq. ft. of shore ½ cu. yd. vegetable matter.
Apr. 10	11:10	Shore between 53rd and 54th st., Brooklyn.	S.	Ebb	Scum of sewage on water; garbage and wood. In 600 sq. ft. of shore ½ cu. yd. vegetable matter.
Apr. 10	11:25	Morse Dry Dock Co., foot 56th st.	S.	Ebb	Scum of sewage on surface, about docks. Driftwood. No odor.
Apr. 10	11:35 a. m.	Foot 57th st.	S.	Ebb	Same as at 56th st.
Apr. 10	12:15	Shore just west of 57th st.	S. E.	Ebb	Scum of sewage. Odor 50 ft. to leeward. In 600 sq. ft. of shore ½ cu. yd. vegetable matter.
Apr. 10	1:10	Foot of 65th st.	S. E.	Ebb	Large sewer running out to pierhead line, under wharf. The sewage sets back toward south, toward Edison Co.'s plant. Water discolored for several hundred yards with sewage. Scum on surface. Odor not bad. Small grease balls on surface of water, the size of marbles.
Apr. 10	1:50	Along shore road of Bay Ridge.	S. E.	Ebb	Small sewers. Scum of sewage on water. No odor.
Apr. 10	2:20	Dock foot 69th st.	S. E.	Flood	Scum of sewage both sides of dock. No odor.
Apr. 10	2:30	South shore of dock.	S. E.	Flood	Water discolored with sewage—scum on surface. Small grease balls. Odor 50 ft. to leeward. Several sewers here run out to beyond low water mark.
Apr. 10	2:50	Foot 71st., Bay Ridge.	S. E.	Flood	Large brick sewer. Water discolored with sewage in 100 yds. radius. Scum grease on surface. Sewage sets toward Narrows (south).
Apr. 10	3:30	71st to 79th st., along shore.	S. E.	Flood	Scum of sewage on surface. Several small sewers. Some driftwood.
Apr. 10	4:10	Foot 79th st.	S. E.	Flood	Sewer, similar to 65th st. sewer, covered, out to pierhead line. Sewage sets toward Narrows (south). Water discolored for several hundred yards. Odor not bad.

Table 20.—*Concluded.*

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1905.	a. m.				
Apr. 11	9:35	Shore between 79th st., Bay Ridge and Crescent Athletic Club.	N. E.	Ebb...	Scum of sewage on surface. Some driftwood. No odor.
Apr. 11	9:50	Back of Crescent Club House.	N. E.	Ebb...	Two sewers. Scum of grease on surface. Driftwood, bottles, tin cans. Sewer at high water mark. Odor 20 ft. to leeward. In 400 sq. ft. of shore 1 cu. yd. vegetable matter.
Apr. 11	10:15	100 yards south Crescent Club.	N. E.	Ebb...	Small sewer out to pierhead line. Scum of grease on surface. Some wood and garbage.
Apr. 11	10:25	Shore on to 88th st.....	N. E.	Ebb...	Less sewage. Considerable wood.
Apr. 11	10:30	Side of private dock south of 88 th st.	N. E.	Ebb...	More sewage. Wood and paper in water.
Apr. 11	11:15	Foot 92nd st.....	N. E.	Ebb...	Big sewer covered out to pierhead line. Scum of sewage both sides pier. Water slightly discolored. Odor not strong. Grand deal of wood nearby.
Apr. 11	11:25	Shore between 92nd st. and low flats south.	N. E.	Ebb...	Fairly free from sewage. Some wood.
Apr. 11	11:25	Off flats (old dock)	N. E.	Ebb...	Hardly any sewage. Two small sewers.
Apr. 11	11:45	Just south of flats.....	N. E.	Ebb...	Water discolored and scum of sewage on surface.
Apr. 11	11:50	Foot 3rd ave.....	N. E.	Ebb...	Seaweed piled up in corner of shore 3 ft. high.
Apr. 11	p. m. 12:00	Foot 4th ave., north of dock.	N. E.	Ebb...	Good deal of sewage. Grease ball 2 in. x 2 in. Garbage and wood. No odor. In 400 sq. ft. of shore 4 cu. yd. vegetable and 1-10 cu. yd. animal matter.
Apr. 11	12:25	Between 4th ave. and Fort Hamilton.	N. W.	Ebb...	Shore free from sewage.

The eastern, or Brooklyn, shore of Upper New York Bay was, for nearly its whole length, obviously polluted with sewage, refuse and garbage. The amount of this pollution diminished in the direction of the Narrows.

Table 21. Results of a sanitary inspection of the shore of the islands in the Upper Bay.

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1905.	a. m.				
Apr. 7	9:10	Governor's Island, immediately west of ferry dock.	N. W.	Ebb...	Sewage in water. Formed feces. No odor. Some wood and fiber. Mattress.
Apr. 7	9:25	Governor's Island, 150 yds. west on north shore.	N. W.	Ebb...	Two sewers. Scum of sewage on surface. Sewage in water. Feces and tissue paper. Horse droppings. Little driftwood. No odor.
Apr. 11	9:45	Governor's Island, 200 yds. west of ferry dock.	N. W.	Ebb...	Sewer. Odor 50 ft. to leeward. Some scum of sewage on surface.

Table 21.—(*Concluded.*)

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	a. m.				
Apr. 7	10:10	Governor's Island, near wharf on north shore.	N. W..	Ebb...	Water discolored with sewage. Scum of grease on surface. Toilet paper, feces. Odor 50 ft. to leeward. Sewer near. Sewage from this sewer.
Apr. 7	10:25	Governor's Island, west side Castle Williams.	N. W..	Ebb...	Water discolored with sewage. Scum of grease on surface. Toilet paper and feces. Odor 20 ft. to leeward. No garbage or wood.
Apr. 7	10:50	Governor's Island, along bulkhead on west shore to retain filling.	N. W..	Ebb...	Large quantity of floating wood, garbage and straw. Scum of sewage on surface, also feces. Some odor. Sewage seemed to come from distance. No sewers near. Current from Brooklyn shore.
Apr. 7	11:10	Governor's Island inlet where filling is being done	W	Ebb...	Scum of grease on surface of water.
Ap. 7.	11:25	Governor's Island inlet, near dredges.	W....	Ebb...	No sewage noticed in mud pumped from Buttermilk channel. No odor.
Apr. 7	11:50	Governor's Island, along bulkhead on south shore.	W....	Ebb...	Some sewage near small sewer at beginning of wall. Very little wood and garbage.
	p. m.				
Apr. 7	12:20	Governor's Island, east shore.	W....	Ebb...	Water discolored with sewage for 200 yds. from nearby sewers. Toilet paper and feces.
Apr. 7	12:30	Governor's Island, cable crossing.	W....	Ebb...	Sewage from sewer here.
Apr. 7	1:20	Ellis Island, ferry slip...	W....	Flood.	Scum of sewage on surface. Some garbage and paper in water. Water discolored with sewage at one point.
Apr. 7	1:35	Ellis Island. New Hospital wharf, south side	W....	Flood.	Some wood and garbage. New wharf being made by dumping between here and Liberty Island. Men seemed to be careful in trimming.
Apr. 7	1:45	Ellis Island, southwest extremity.	W....	Flood.	Slight scum of sewage on surface.
Apr. 7	2:00	Ellis Island, west shore opposite Black Tom.	W....	Flood.	Sewer near. Water discolored with sewage. Scum of grease on surface. Shore and water covered with paper, rags, wood, tin cans, garbage. Great quantity of garbage. In 400 sq. ft. shore 1-10 cu. yd. vegetable and 1-40 cu. yd. animal matter.
Apr. 7	2:10	Ellis Island, off coal dock	W....	Flood.	Scum of sewage on surface.
Apr. 7	2:15	Ellis Island, north shore opposite Lehigh Valley freight station, Communipaw.	W....	Flood.	Scum of sewage from nearby sewers. No odor. Feces in water.
Apr. 7	2:25	Ellis Island, east shore, opposite Manhattan.	W....	Flood.	No garbage or sewage along docks.
Apr. 7	3:20	Liberty Island, north side toward Ellis Island.	W....	Flood.	Water muddy from wind. Could not detect sewage. Bones on shore. Two or three small sewers. No odor.
Apr. 7	3:35	Liberty Island, west shore, opposite National docks.	W....	Flood.	Scum of sewage on surface, straw and driftwood. No sewers on this shore. Water not discolored with sewage. No odor.
Apr. 7	3:50	Liberty Island, south shore Liberty Island, opposite Staten Island.	W....	Flood.	Considerable sewage in water. Scum of grease on surface all along shore. Only one small sewer on this shore. The sewage comes from a distance. No odor. Water somewhat discolored with sewage. Some straw on water.
Apr. 7	4:20	Liberty Island, east shore Liberty Island, near boat landing.	W....	Flood.	Slight scum of sewage on surface. Considerable wood. Some garbage in the water.

The shores of the islands of the Upper Bay were, for the most part, comparatively clean, except for sewage which was evidently discharged from buildings on the islands themselves. There were points, however, on Governor's Island and Liberty Island where remains of sewage were found which could not have originated nearby. This was long range pollution of the most objectionable character.

Table 22. Results of a sanitary inspection of the shores of New York Bay from the Narrows to Coney Island and Sheepshead bay.

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	p. m.				
Apr. 11	1:10	Shore at north end of Fort Hamilton.	N. W..	Ebb...	Slight scum of sewage near dock. Shore fairly clean.
Apr. 11	1:20	Shore between the two docks.	N. W..	Ebb...	Shore along wall fairly free from sewage. Some wood.
Apr. 11	1:40	Just north of coal dock..	N. W..	Ebb...	Large sewer at high water mark. Water discolored. Scum on surface. Odor 30 ft. to leeward.
Apr. 11	2:05	South of dock.....	N. W..	Ebb...	Goood deal of driftwood. Very little sewage.
Apr. 11	2:35	South end of Fort Hamilton.	N. W..	Flood.	Seaweed, garbage and wood. No sewage.
Apr. 11	3:10	Shore between Fort Hamilton and first dock, foot 9th st., Bath Beach.	N. W..	Flood.	Free from sewage, except at opening of sewer 400 yds. south of Fort Hamilton. Some seaweed, garbage and driftwood. In 400 sq. ft. of shore 1-20 cu. yd. vegetable matter.
Apr. 11	4:15	Dock at foot of Bay, 9th st., Bath Beach.	N. W..	Flood.	Sewer under dock out to pierhead line. Some scum of sewage on surface. No odor.
	a. m.				
Apr. 12	10:00	Foot Bay 13th st., Bath Beach.	N. W..	Flood.	Shore clean. No sewage visible in water.
Apr. 12	10:20	Foot Bay 15th st.....	N. W..	Ebb...	Same. Some wood.
Apr. 12	10:35	Foot Bay 17th st.....	N. W..	Ebb...	Sewer here. Scum of sewage on water. Odor 50 ft. to leeward. Driftwood and garbage. In 400 sq. ft. of shore 1 cu. yd. animal matter.
Apr. 12	10:50	Foot Bay 19th st.....	N. W..	Ebb...	Shore clean. No sewage.
Apr. 12	11:15	Foot Bay 25nd st.....	N. W..	Ebb...	Shore clean. No sewage.
Apr. 12	11:25	Foot Bay 23rd st.....	N. W.	Ebb...	No sewage. Some straw and wood.
Apr. 12	11:40	Foot 21st ave., Bensonhurst.	N. W..	Ebb...	Some driftwood and garbage. No sewage.
Apr. 12	11:55	Foot Bay 32nd st., Bensonhurst.	N. W.	Ebb...	No sewage. Some wood.
	p. m.				
Apr. 12	12:15	Foot Bay 36th st.....	N. W..	Ebb...	No sewage. Some wood.
Apr. 12	1:10	Shore of bathing pavilion, Ulmer Park.	N. W..	Ebb...	Scum of sewage on surface of water, in spots. Wood, rags, paper, and garbage on shore. In 400 sq. ft. of shore ¼ cu. yd. vegetable matter.
Apr. 12	1:40	Off Marine Basin Co. dock.	N. W..	Ebb...	No sewage in water at end of docks. On Gravesend bay side slight scum of grease in places.

Table 22.—(*Continued.*)

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	p. m.				
Apr. 12	2:05	East shore of Gravesend bay, south of marine dock.	N. W..	Ebb...	Seaweed, straw and wood. No sewage visible.
Apr 12	2.35	East shore Gravesend bay. Back of fishing docks.	N. W..	Ebb...	Seaweed, straw and wood. No sewage visible.
Apr. 12	3:10	Same shore near Coney Island creek outlet...	N. W..	Ebb...	Slight scum on surface from waters of creek. No odor.
Apr. 12	3:50	Same shore, along flats near Coney Island.	N. W..	Ebb...	No sewage. Some seaweed.
Apr. 12	4:20	Bridge over Coney Island creek.	N. W..	Ebb...	Several sewers empty into creek between bridge and Gravesend bay. Scum of sewage on surface of creek. No odor.
	a. m.				
Apr. 13	10:05	South shore of Gravesend bay from Coney Island creek to Sea Gate.	N. W..	Flood.	Scum of sewage on surface; feces, house sweepings and toilet paper on water. About 12 sewers along this shore, one at foot of each street. Odor not bad.
Apr. 13	10:55	Southwest shore of Gravesend bay.	N. W..	Flood.	Good deal of driftwood on shore. Scum of sewage on water. In 400 sq. ft. of shore ½ cu. yd. vegetable matter.
Apr 13	11:25	Shore of Gravesend bay, around east side of Norton's Point.	S....	Ebb...	Great quantity of driftwood and some garbage on shore. Scum of sewage on surface of water. Grease balls 3 in. x 3 in. No sewers nearby. Driftwood and sewage backs in from New York bay with the tide. (Men gathering wood on shore, said new supply came in every day.) In 400 sq. ft. of shore 3 cu. yds. vegetable matter, mostly wood, 1-20 cu. yd. animal matter.
Apr. 13	11:50	Shore off Norton's Point to Atlantic Yacht Club House at end of Gravesend bay.	S.....	Ebb...	Scum of sewage on surface. Two grease balls, 2 x 2 and 3 x 3 inches. No odor of sewage. Some garbage and driftwood on water.
	p. m.				
Apr. 13	12:25	Shore of New York bay, Sea Gate west of Norton's Point.	S.....	Ebb...	Immense quantity of driftwood. In 400 sq. ft. of shore, 5 cu. yds. Some garbage, straw and bottles. No sewage on water. Grease ball on shore 2 x 2 in.
Apr. 13	1:20	Shore off Sea Gate to Coney Island light.	S. E...	Ebb...	Great quantity of driftwood. Some garbage. No sewage detected.
Apr. 13	2:15	South shore Sea Gate from light to Seabourne hotel.	S. E...	Ebb...	Some driftwood where shore runs back some distance. Some seaweed. Very little garbage. No evidence of sewage.
Apr. 13	3:10	Seabourne Hotel to Sea Gate Beach Hotel	S. E...	Ebb...	Not much driftwood. Some straw on shore and seaweed No sewage.
Apr. 13	3:55	Sea Gate Beach hotel to Steeplechase Park, Coney Island.	S. E...	Ebb...	Not much driftwood or garbage. Considerable amount of straw and seaweed. No sewage.
Apr. 13	4:20	Off Steeplechase Park...	S. E...	Ebb...	Shore very clean all along here.
Apr. 14	9:30	Coney Island shore from Steeplechase Park to Dreamland.	S. E...	Flood.	Shore quite clean Some seaweed and driftwood. No remains of sewage visible.
Apr. 14	9:55	Shore of Dreamland....	S. E...	Flood.	Some seaweed.
Apr. 14	10:25	Beach from Dreamland to iron pier.	S. E...	Flood.	Small quantity of seaweed. No garbage or sewage.
Apr. 14	10:50	Palmer's bathing beach.	S. E...	Flood.	Beach clean.
Apr. 14	11:15	Municipal shore east of Palmer's.	S. E...	Flood.	Some seaweed.
Apr. 14	11:45	Parkway baths, south..	S. E...	Flood.	Large quantity of seaweed on shore. In 400 sq. ft. of shore 2 cu. yds. of seaweed.
	p. m.				
Apr. 14	12:20	Between Parkway baths and Brighton Beach hotel.	S. E...	Ebb...	Large quantity seaweed, 4 cu. yds. in 400 sq. ft. of shore. Dead dog.

Table 22.—(*Concluded.*)

Date.	Time.	Place.	Wind.	Tide.	Condition of shore.
1906.	*p. m.*				
Apr. 14	1:15	Shore just east of Brighton Beach hotel.	S. E...	Ebb...	Immense quantity seaweed. Six cu. yds. in 400 sq. ft. of shore. Some driftwood. Small quantity garbage.
Apr. 14	1:50	Shore front of Manhattan Beach hotel.	S. E...	Ebb...	Some seaweed along seawall.
Apr. 14	2:20	From Manhattan Beach hotel to Oriental.	S. E...	Ebb...	Seaweed on water along seawall.
Apr. 14	2:45	Front of Oriental hotel..	S. E...	Ebb...	Seaweed along seawall.
	a. m.				
Apr. 16	9:20	Sheepshead bay foot of shore road.	N.....	Flood.	Scum of sewage on surface near shore. Small amount of garbage and seaweed. No odor.
Apr. 16	9:50	Shore road to Ocean ave.	N.....	Flood.	No sewage noticed.
Apr. 16	10:25	Ocean ave. to foot East 23rd st.	N. W..	Flood.	Some seaweed. No sewage.
Apr. 16	10:45	East 23rd st. to East 27th st.	N. W..	Flood.	Shore quite clean.
Apr. 16	11:35	Foot 27th st. to end of Emmons ave., extreme east end Sheepshead bay.	N. W..	Flood.	Some seaweed. No sewage found along shore.
Apr. 16	1:10	Pumping station east end of town.	N.....	Flood.	Water in Sheepshead bay stirred up by dredger, filling in flats between bay and Manhattan Beach. Very little sewage detected in bay. Only slight scum at certain points. No odor. Sewage of Sheepshead Bay (town) is pumped to eastern extremity of town, east of race track, mixed with chlorinated lime, the liquid part discharged into Bull's Creek and the solid siphoned out onto the flats nearby. There was no odor where deodorized contents of deposit tanks were discharged April 14. There are oyster beds in Bull's Creek where liquid part of sewage empties.
Apr. 16	2:35	[South shore of Sheepshead bay from Coney Island creek to bridge.	N.....	Ebb...	Shore clean. Scum of sewage at one point near opening of creek.
Apr. 16	3:15	South shore from bridge to Oriental hotel.	N. W..	Ebb...	No sewage on water. Shore clean.
Apr. 16	3:55	Point east of Oriental hotel.	N. W..	Ebb...	Sewage from Manhattan Beach and Oriental hotels pumped to pumping station here, and after treatment with lime, emptied into New York bay, just outside of seawall.

On comparing table 22 with 18 it will be seen that both shores of the Lower Bay were polluted for a considerable distance from the Narrows. The Staten Island shore contained large quantities of garbage as far as the inspections were continued in that direction, that is, Midland Beach. The north shore of the Lower Bay was
fairly free from visible evidences of sewage and other pollu-
44 tion, except near the outlets of local sewers, where occasionally small amounts of sewage scum were seen floating at a considerable distance from the shore.

The presence in this vicinity of large grease balls which could only have been derived from sewers of considerable length, showed that some sewage was evidently transported to these shores from Brooklyn sewers which emptied into the Upper Bay.

That portion of the shore of the outer harbor which lies in the vicinity of Norton's Point contained so much driftwood, garbage and sewage matter that it seems reasonable to conclude that this point is a collecting center for refuse which flows out of the Narrows. As much as 5 cubic yards of animal and vegetable refuse were found on 400 square feet of beach in this vicinity. Men who were found gathering wood here said that the supply of fuel was inexhaustible.

From Norton's Point eastward there was a constantly diminishing amount of putrescible refuse until, about midway between the two ends of Coney Island, it was reduced to an occasional lot of garbage or a dead animal or so. The shores and water of Sheepshead Bay were fairly clean, as might be expected at this season of year.

Inspections confirmed what the chemical and bacteriological analyses of the commission had already shown concerning the objectionable practice of cultivating oysters in the creeks in the immediate vicinity of New York.

Bodine creek, on Staten Island, where large quantities of oysters are "drinked" in preparation for market was reported by the inspector to be obviously polluted with sewage. The shores were strewn with vegetable and animal matters and a scum of grease and
petroleum was on the water.

45 Equally objectionable conditions connected with the oyster industry were found elsewhere. The liquid part of the sewage of the town of Sheepshead Bay was found to be emptied, after being treated with chemicals, into Bull's creek in the immediate proximity of oyster beds.

The danger of polluting oysters in these ways was clearly pointed out in the first report of the New York Bay Pollution Commission. The existence of the resulting danger to the public health was em-

phasized by a typhoid oyster outbreak which occurred at Lawrence, N. Y., in 1904, and was investigated and reported on by me.

D—Conclusions.

The principal conclusions which it seems proper to draw from the foregoing investigations are in conformity with the conclusions recorded in the first report of the commission. They are as follows:

1. The waters of the bay and adjacent waters are unmistakably, but not as yet badly, polluted.

2. The sewage is not uniformly dispersed and diffused throughout the depth and breadth of the tidal currents. The discharge of crude sewage results in polluting the water more at the surface than in the depths below.

3. The discharge of sewage along the shores often leads to the production of a decided local nuisance.

4. Although the present method of disposing of the sewage of Manhattan is, perhaps, as acceptable as any method of emptying crude sewage into these waters could be, it is far from being always satisfactory.

5. The disposal of sewage at the pierhead line, as practiced on Manhattan Island is much to be preferred to the plan of
46 emptying it at the bulkhead line as is generally practiced elsewhere in this vicinity.

6. There is no doubt but that offensive matters from the sewage, and the sewage itself, are sometimes transported long distances by the tides and winds and deposited on shores remote from any sewer outlet.

7. Excepting in such heavily polluted waters as Gowanus Canal, there is probably always enough oxygen in the water to enable the bacteria of decomposition to carry on their work without the production of offensive odors.

8. No other method of disposing of the sewage of New York and vicinity is suggested as the result of these investigations. It is evident that some other method should be devised, if practicable, but the satisfactory study of this question involves investigations of a far more exhaustive character and of a wider scope than have thus far been possible.

47 I, George R. Van Namee, Clerk of the Assembly, do hereby certify that the aforegoing is a true and correct copy of Assembly Document No. 76 as filed at this office, being a Report of the New York Bay Pollution Commission of May 3rd, 1903, and of the whole thereof.

[Seal Clerk of Assembly, State of New York.]

GEORGE R. VAN NAMEE,
Clerk of the Assembly.

Dated at Albany, N. Y., this 30th day of September, 1913.

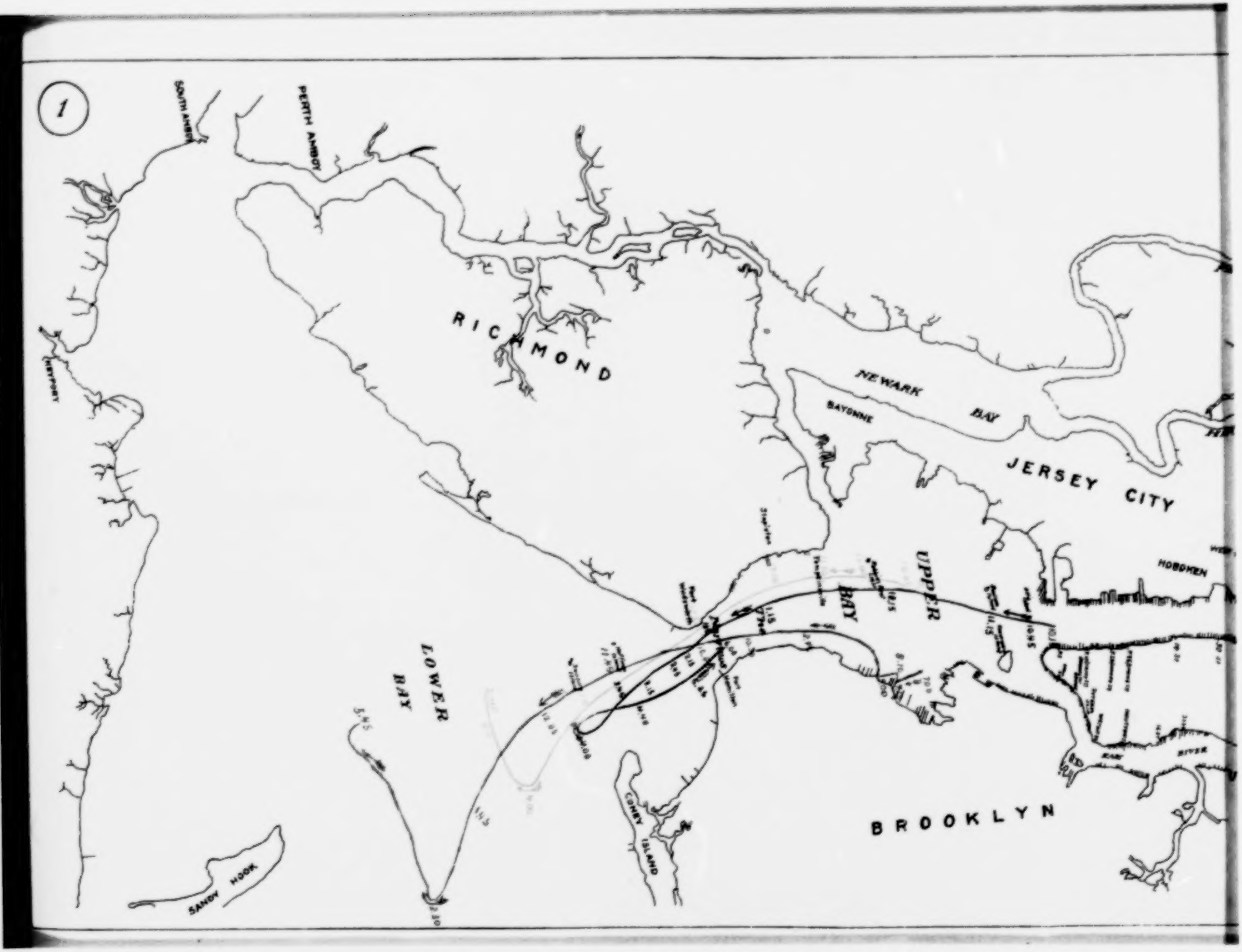
THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 4.

JAMES D. MAHER,
Commissioner.

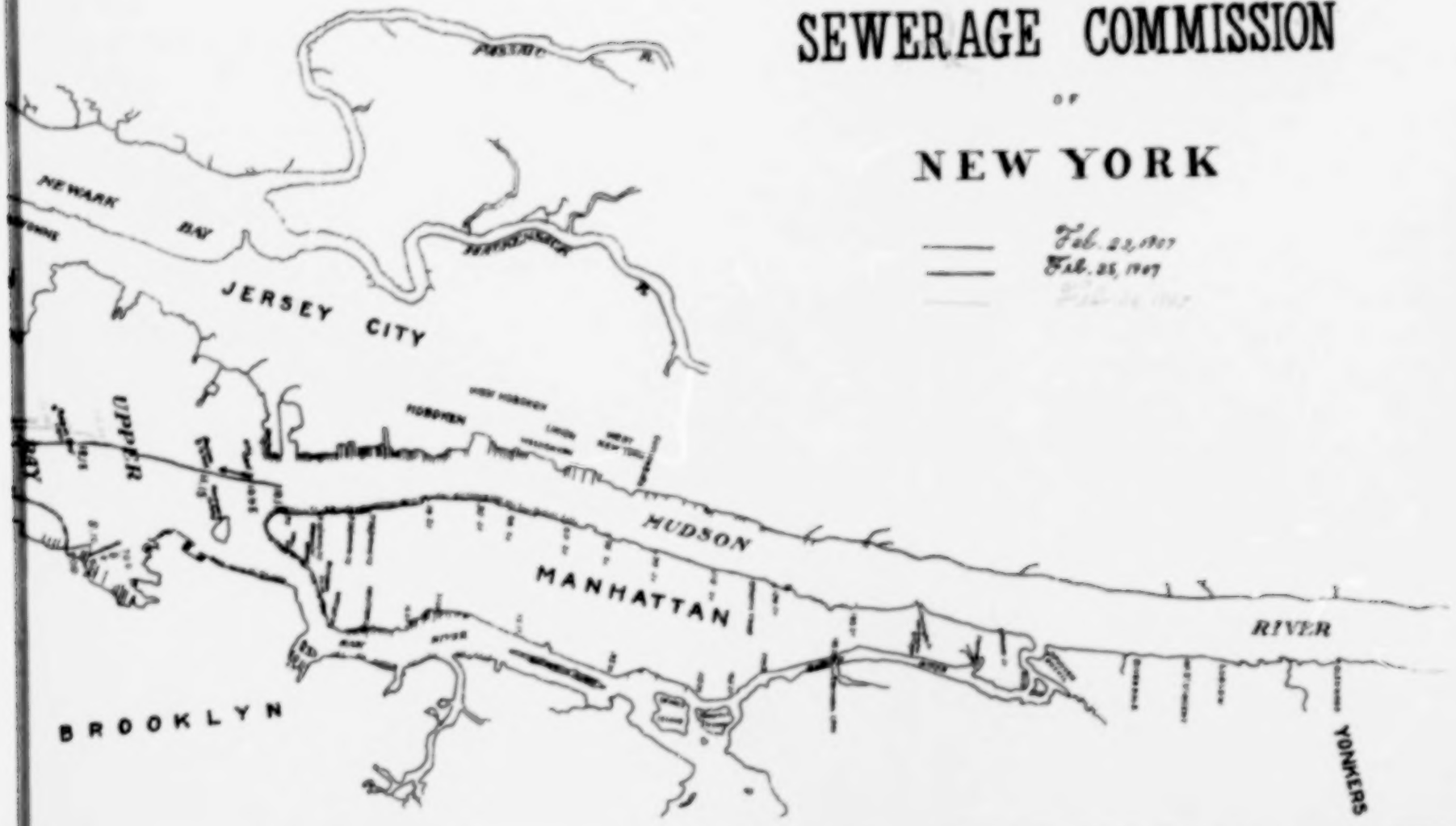


1
SOUTH AMBOY
PERTH AMBOY
KEYPORT
RICHMOND
NEWARK BAY
BAYONNE
JERSEY CITY
HOBOKEN
UPPER BAY
LOWER BAY
CONEY ISLAND
BROOKLYN
SANDY HOOK
EAST RIVER

Complainant's Exhibit No. 14.
James D. Maher
Commissioner

METROPOLITAN SEWERAGE COMMISSION OF NEW YORK

Feb. 22, 1907
Feb. 25, 1907



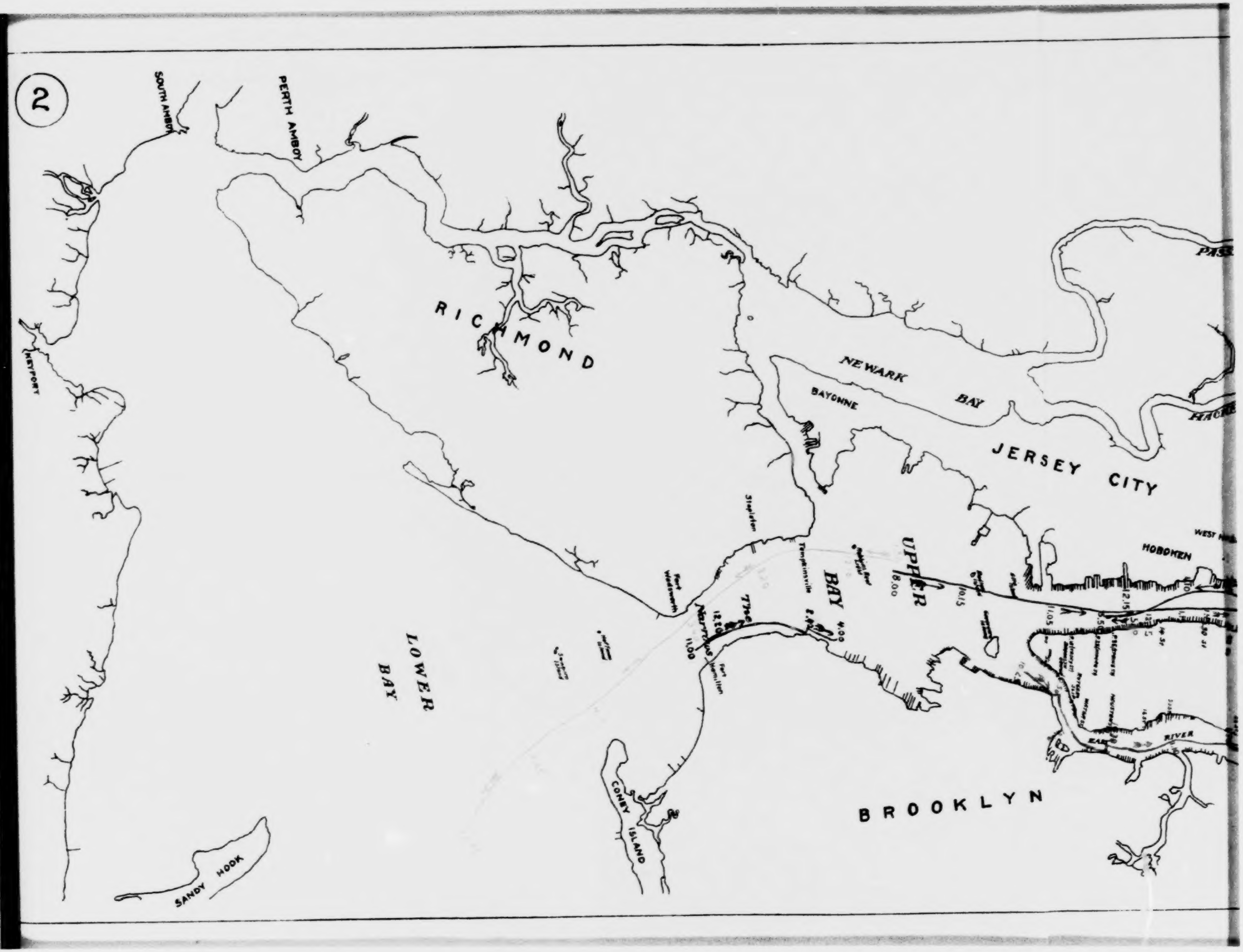
THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 5.

JAMES D. MAHER,
Commissioner.


2
SOUTH AMBOY
PERTH AMBOY
RICHMOND
KEYPORT
NEWARK BAY
BAYONNE
JERSEY CITY
HOBOKEN
Stapleton
Fort Wadsworth
Tompkinsville
UPPER BAY
LOWER BAY
Fort Hamilton
CONEY ISLAND
SANDY HOOK
BROOKLYN
EAST RIVER
8.00
10.15
11.00
12.15
4.00

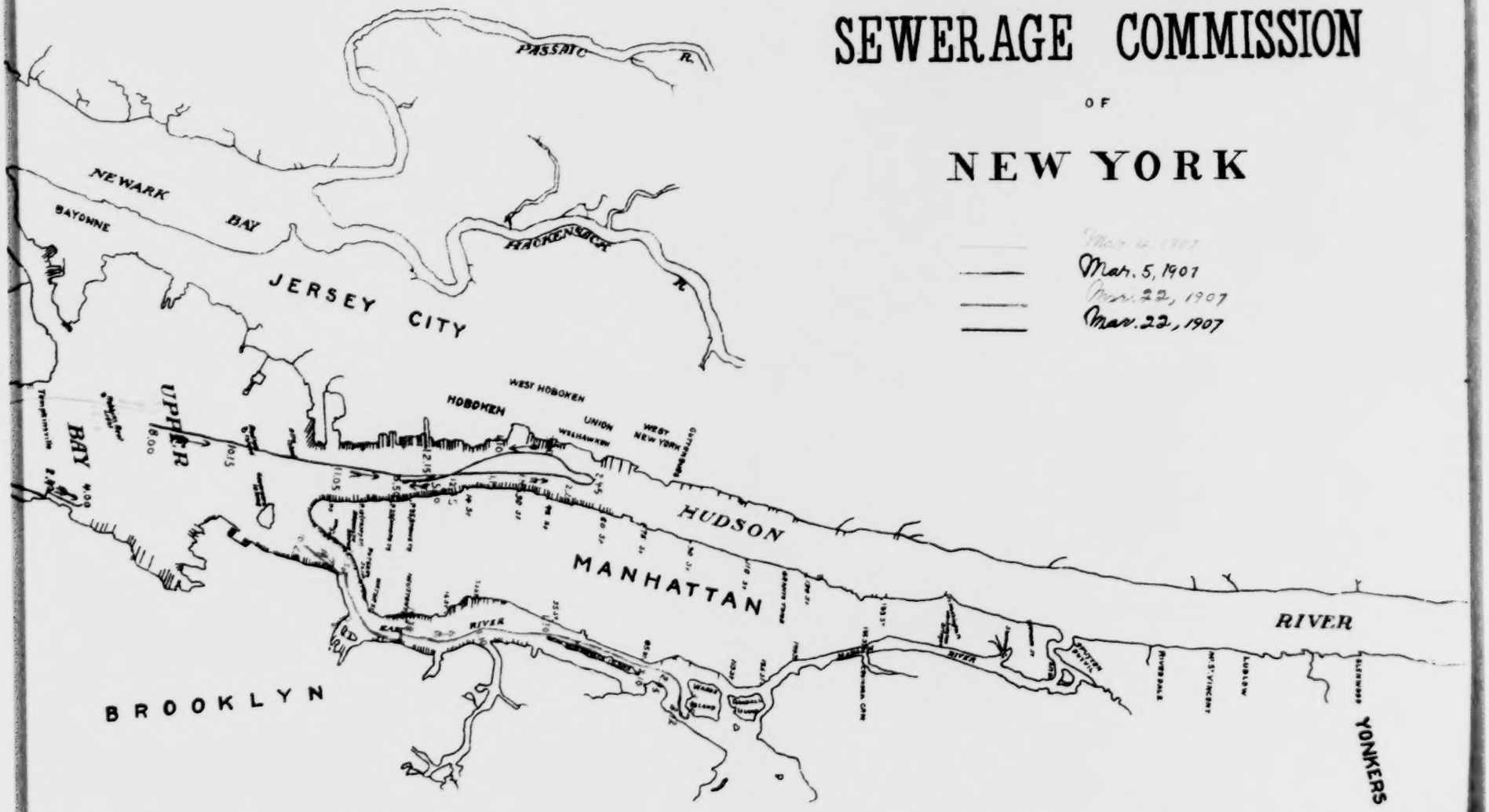
Complainant's Exhibit No. 1.
James Dimock
Commissioner

METROPOLITAN SEWERAGE COMMISSION

OF

NEW YORK

Mar. 5, 1907
Mar. 22, 1907
Mar. 22, 1907



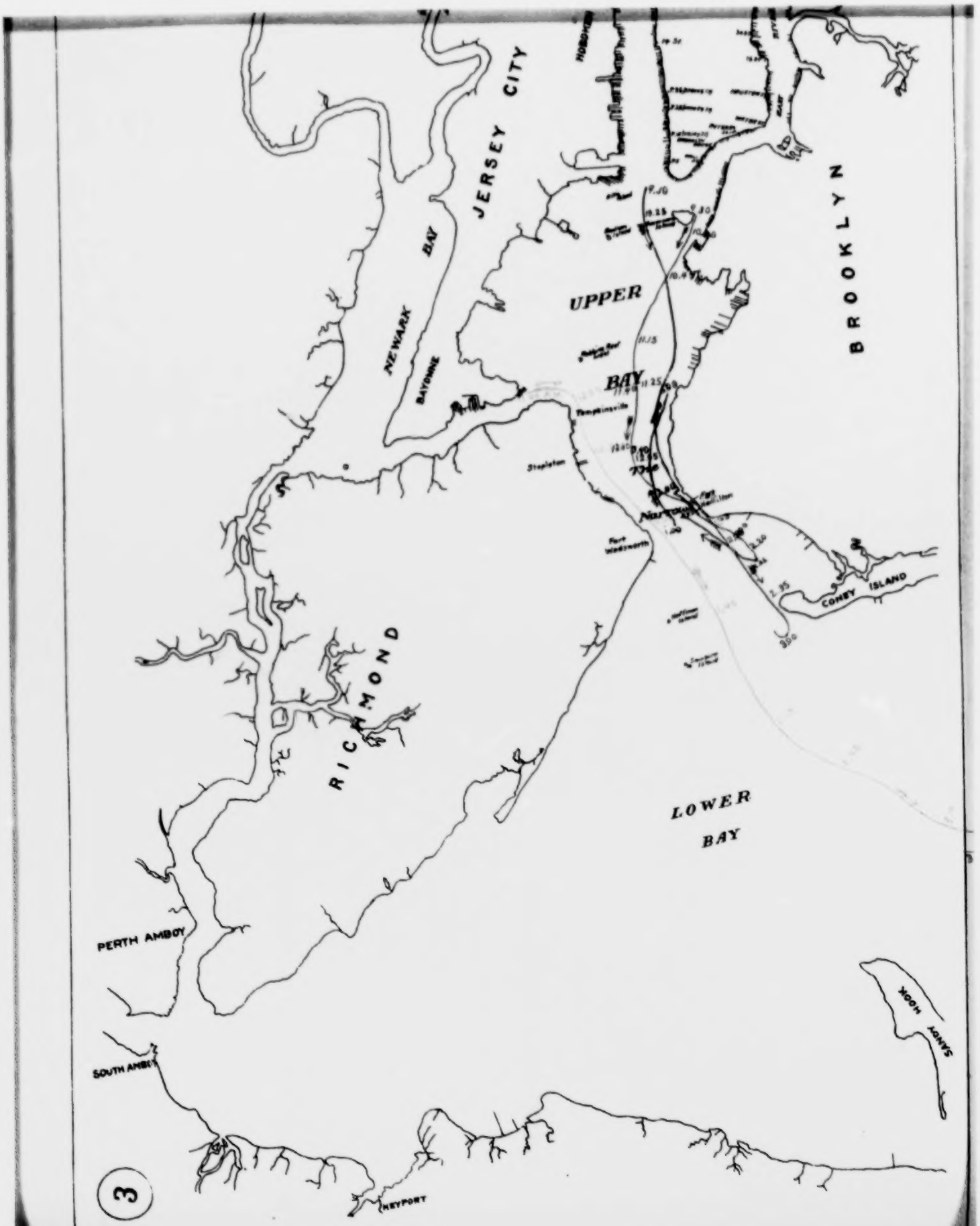
THE PEOPLE OF THE STATE OF NEW YORK.
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 6.

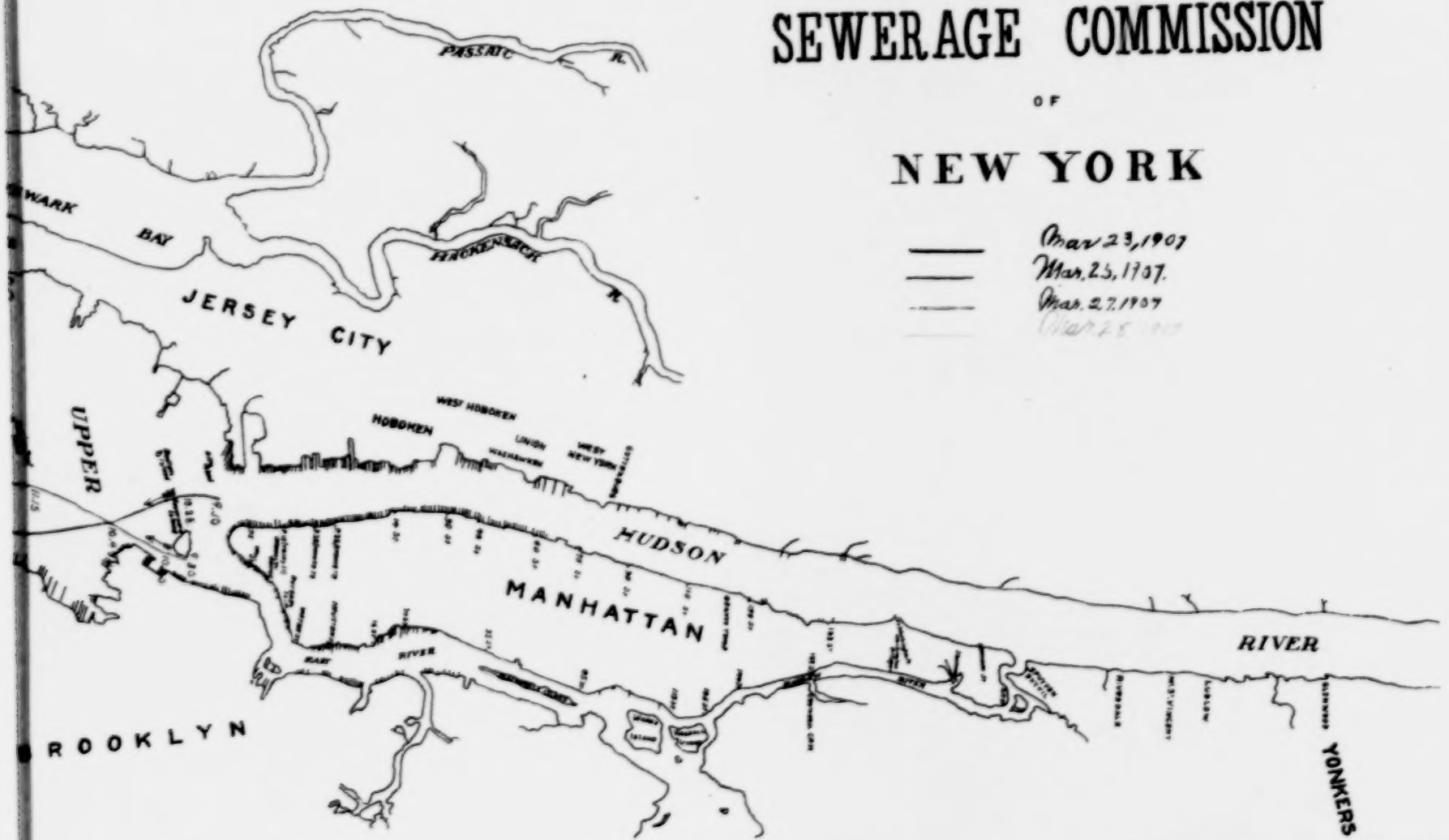
JAMES D. MAHER,
Commissioner.


JERSEY CITY
NEWARK BAY
BAYONNE
UPPER
BAY
BROOKLYN
CONEY ISLAND
RICHMOND
LOWER
BAY
PERTH AMBOY
SOUTH AMBOY
SANDY HOOK
KEYPORT
3

Complainant's Exhibit No. 6.
James D. Maher,
Commissioner

METROPOLITAN
SEWERAGE COMMISSION
OF
NEW YORK

Mar 23, 1907
Mar. 25, 1907.
Mar. 27, 1907



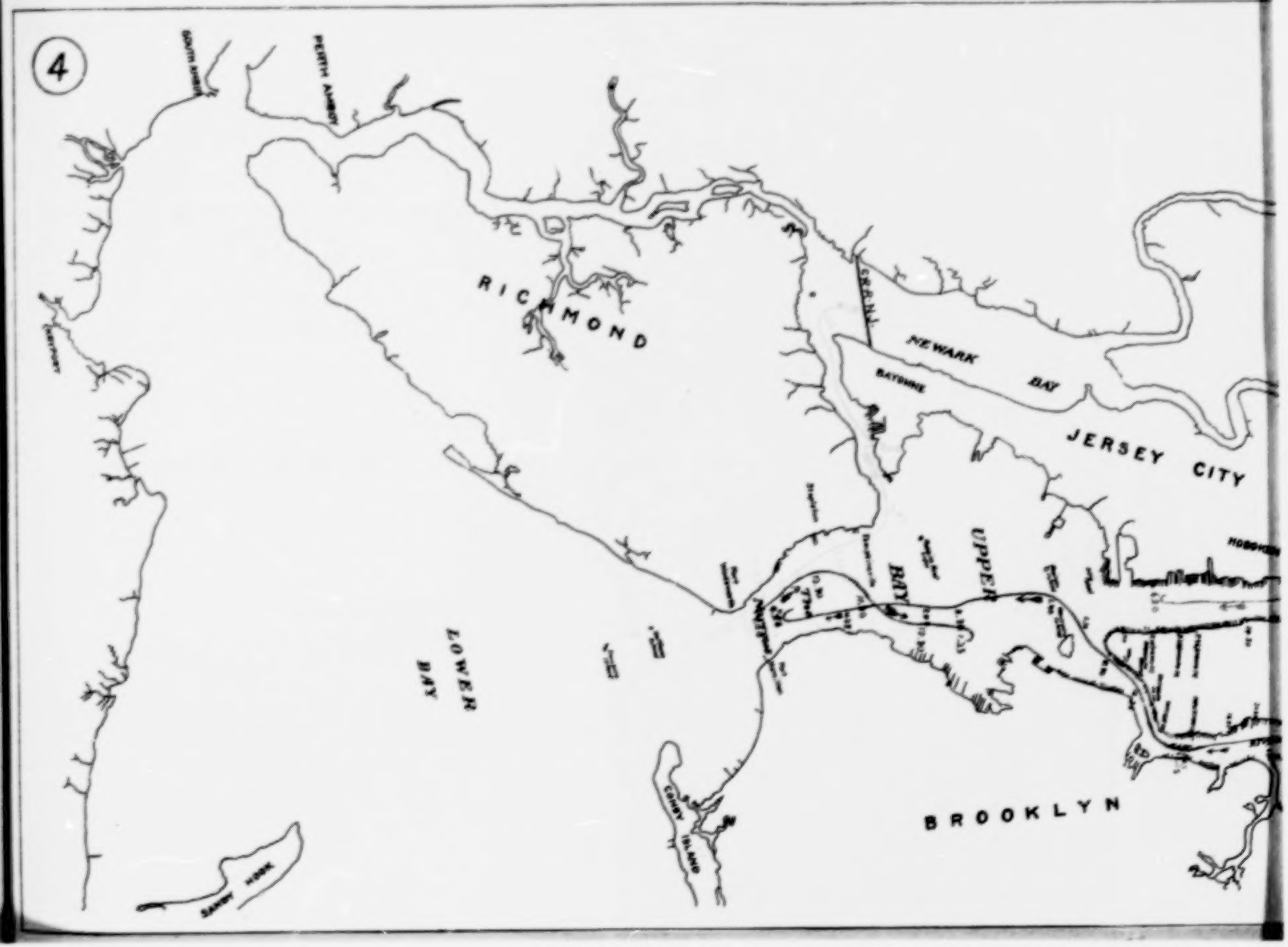
THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 7.

JAMES D. MAHER,
Commissioner.


4
SOUTH AMBOY
PERTH AMBOY
RICHMOND
NEWARK BAY
BAYONNE
JERSEY CITY
HOBOKEN
UPPER BAY
LOWER BAY
BROOKLYN
CONEY ISLAND
SANDY HOOK

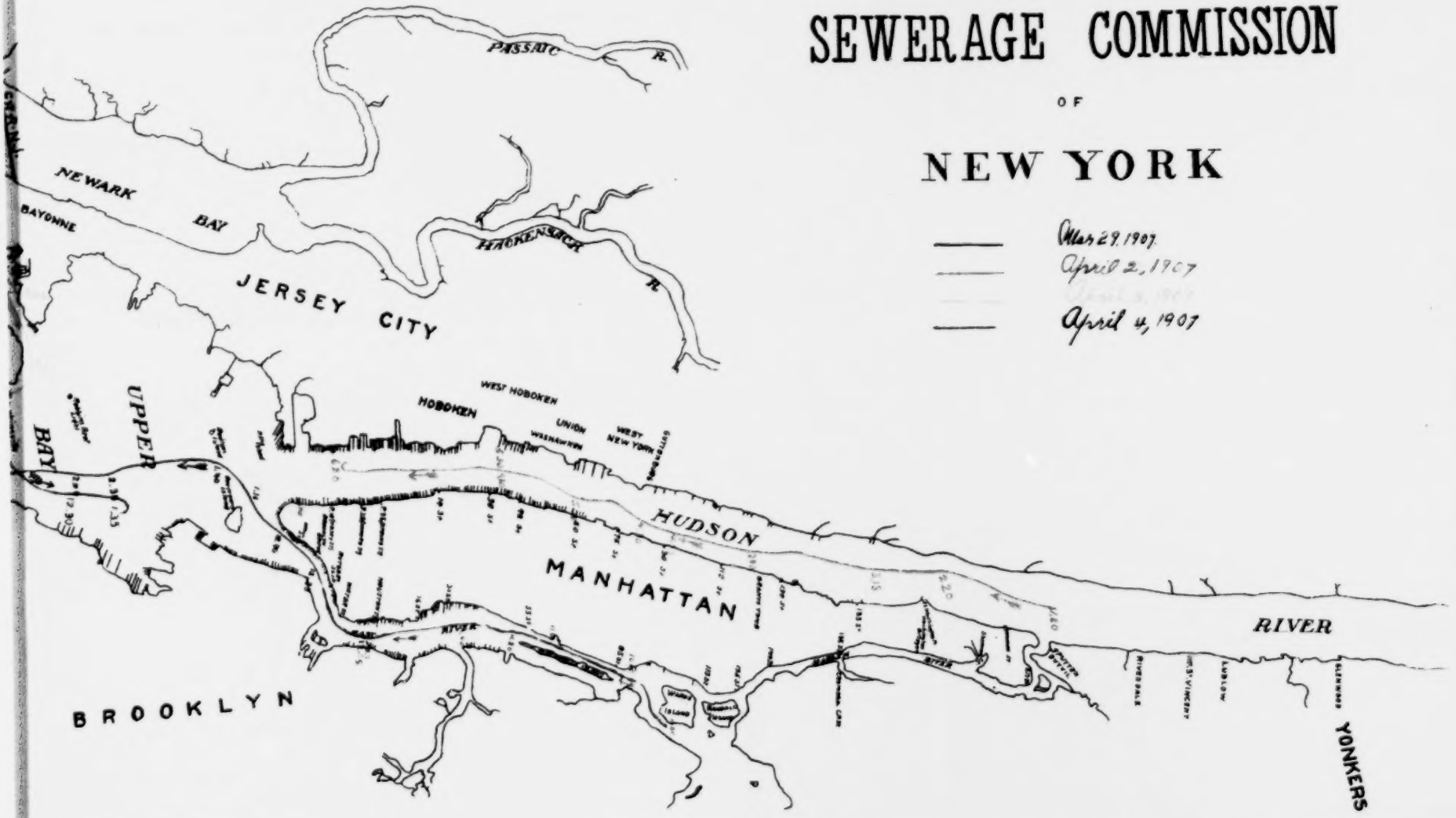
Complainant's Exhibit No. 7.
James D. Maher,
Commissioner.

METROPOLITAN SEWERAGE COMMISSION

OF

NEW YORK

— May 29, 1907.
— April 2, 1907.
— April 4, 1907.



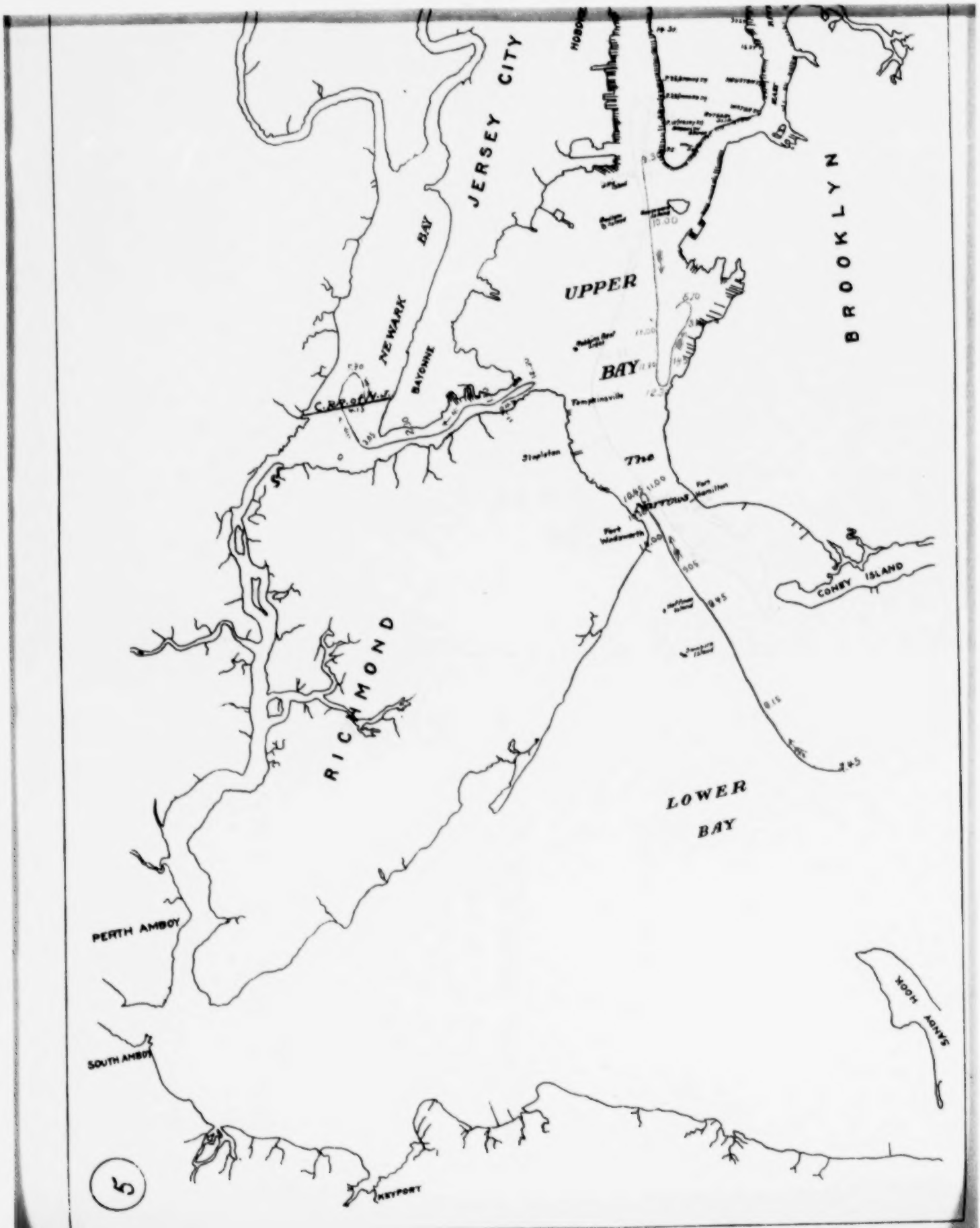
THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 8.

JAMES D. MAHER,
Commissioner.


JERSEY CITY
NEWARK BAY
BAYONNE
UPPER BAY
BROOKLYN
CONEY ISLAND
RICHMOND
LOWER BAY
PERTH AMBOY
SOUTH AMBOY
SANDY HOOK
KEYPORT
5

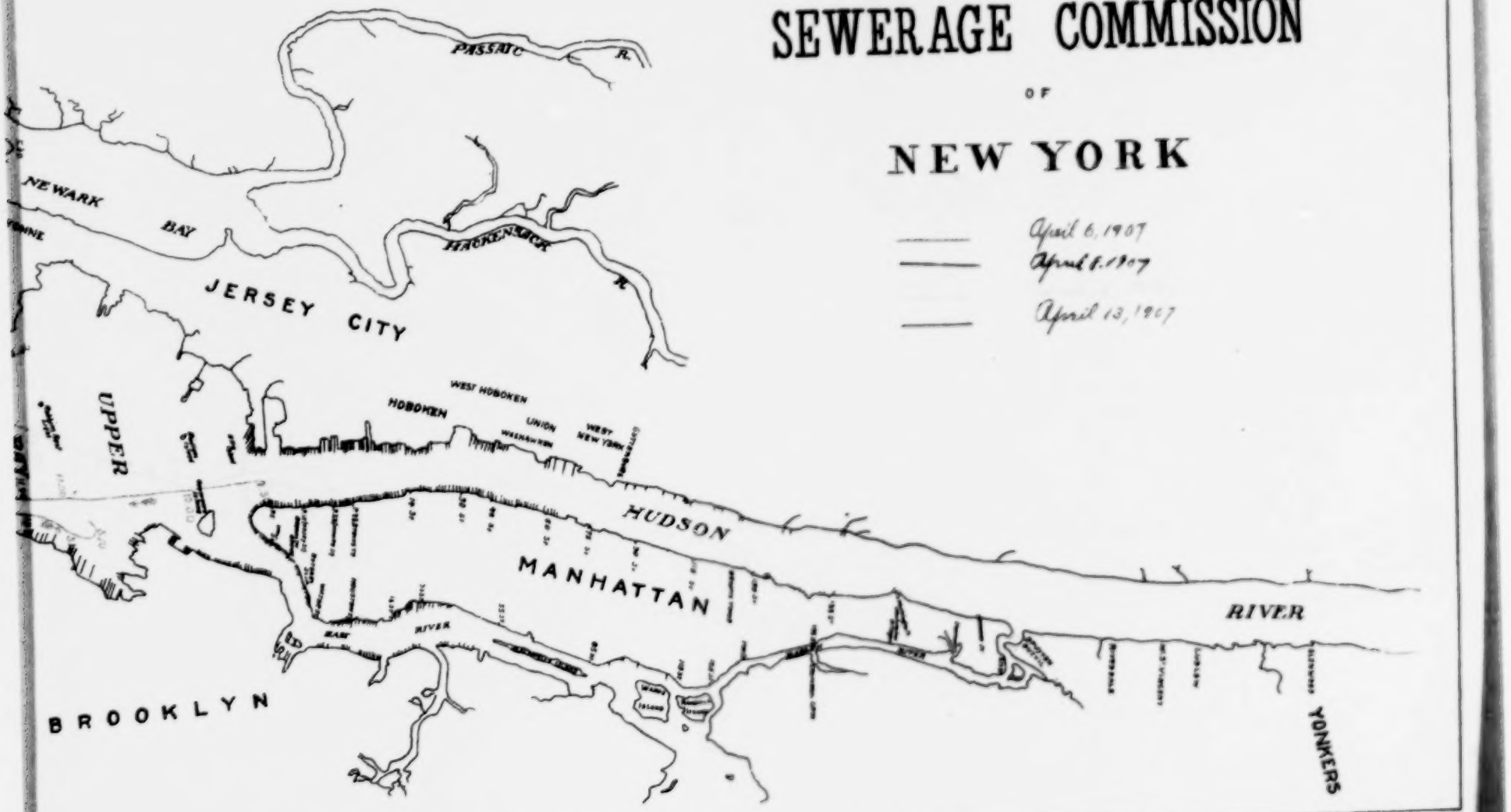
Complainant's Exhibit No. 8.
James A. Mabie,
Commissioner

METROPOLITAN SEWERAGE COMMISSION

OF

NEW YORK

April 6, 1907
April 8, 1907
April 13, 1907



THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

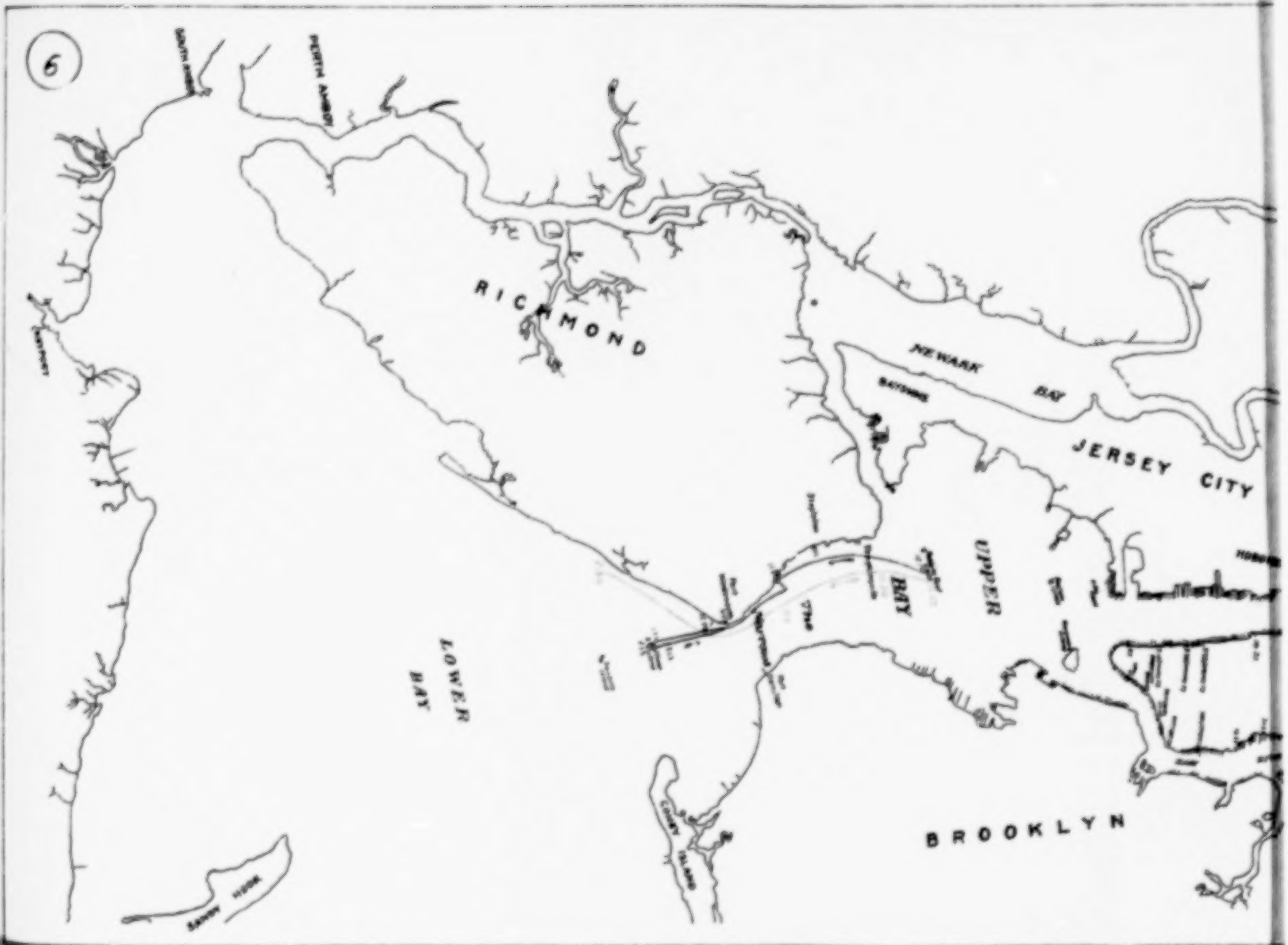
VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 9.

JAMES D. MAHER,
Commissioner.

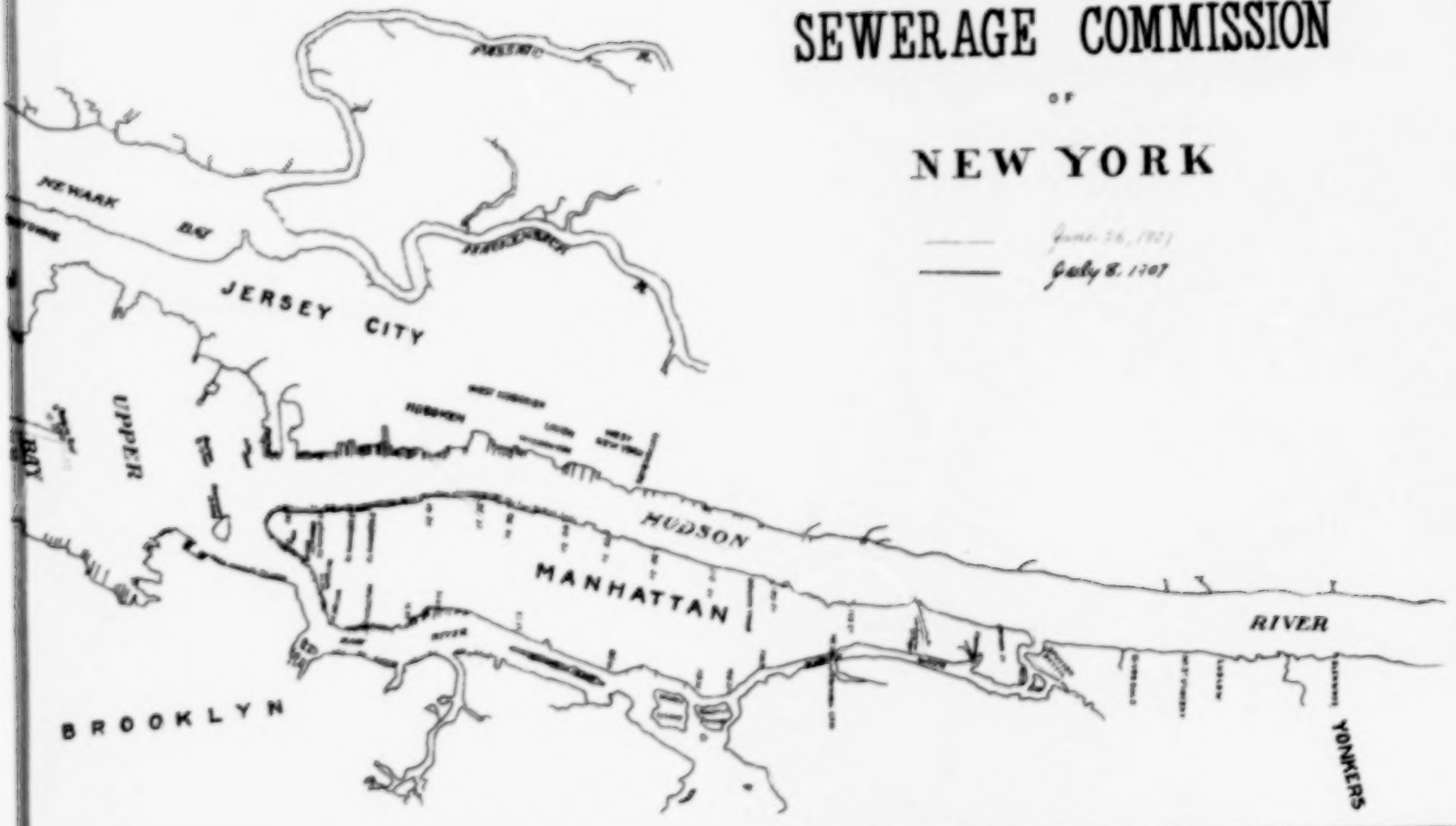
6


RICHMOND
NEWARK BAY
JERSEY CITY
UPPER BAY
LOWER BAY
BROOKLYN
PERTH AMBOY
SANDY HOOK
CONEY ISLAND

Complainant's Exhibit No. 9.
James D. Maher
Commissioner

METROPOLITAN SEWERAGE COMMISSION OF NEW YORK

June 26, 1907
July 8, 1907



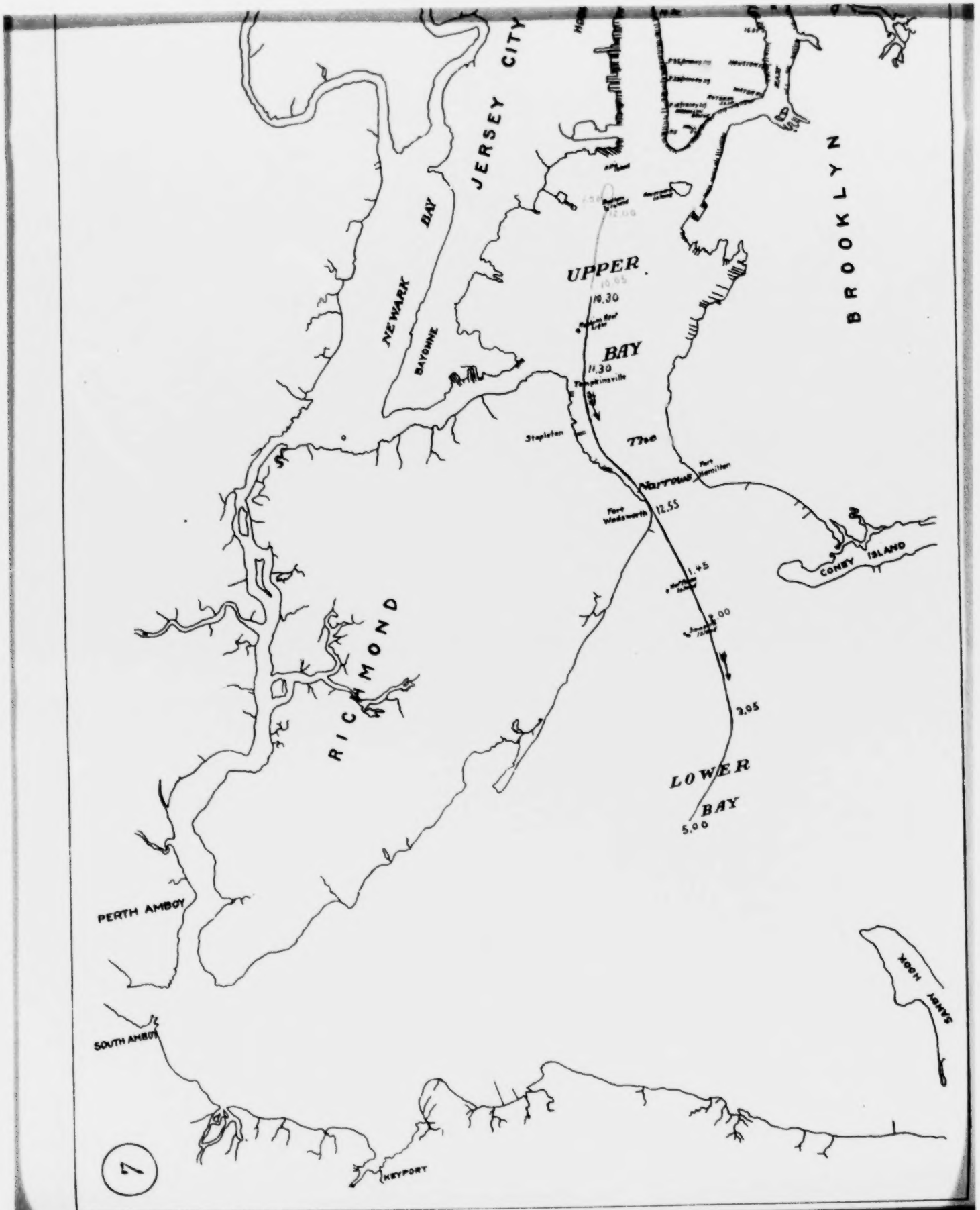
THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 10.

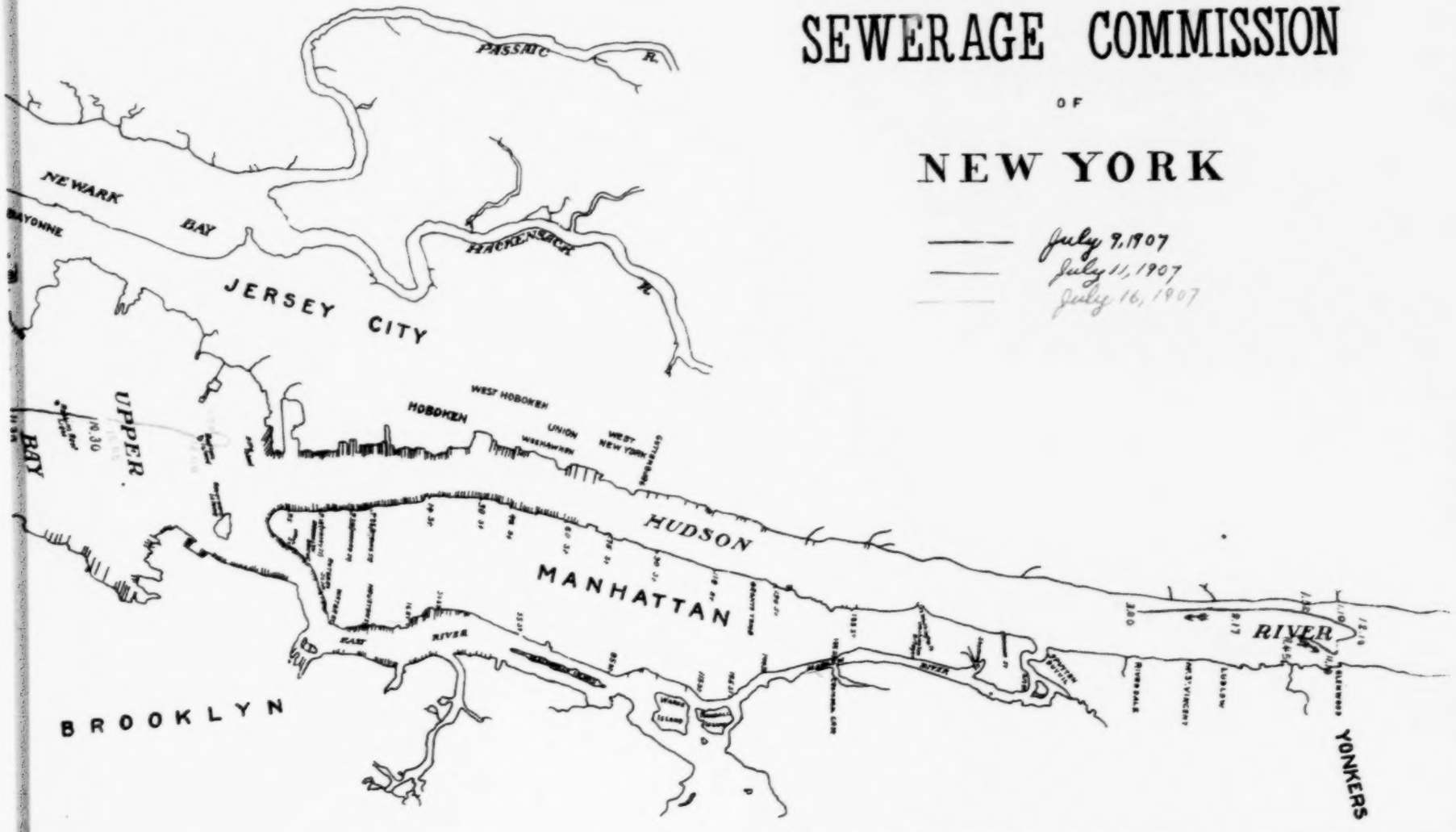
JAMES D. MAHER,
Commissioner.


JERSEY CITY
NEWARK BAY
BAYONNE
BROOKLYN
UPPER
BAY
10.30
11.30
Stapleton
7?ee
Narrows
Fort Hamilton
Fort Wadsworth
12.55
CONEY ISLAND
1.45
2.00
2.05
LOWER
BAY
5.00
RICHMOND
PERTH AMBOY
SOUTH AMBOY
SANDY HOOK
KEYPORT
7

Complainant's Exhibit No. 10.
James A. Maher
Commissioner.

METROPOLITAN
SEWERAGE COMMISSION
OF
NEW YORK

July 9, 1907
July 11, 1907
July 16, 1907



THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 11.

JAMES D. MAHER,
Commissioner.


JERSEY CITY
NEWARK BAY
BAYONNE
UPPER
BAY
BROOKLYN
Stapleton
Narrows
Fort Wadsworth
CONEY ISLAND
RICHMOND
LOWER
BAY
PERTH AMBOY
SOUTH AMBOY
SANDY HOOK
NEWPORT
8

Complainant's Exhibit No. 11.
James D. Maher,
Commissioner.

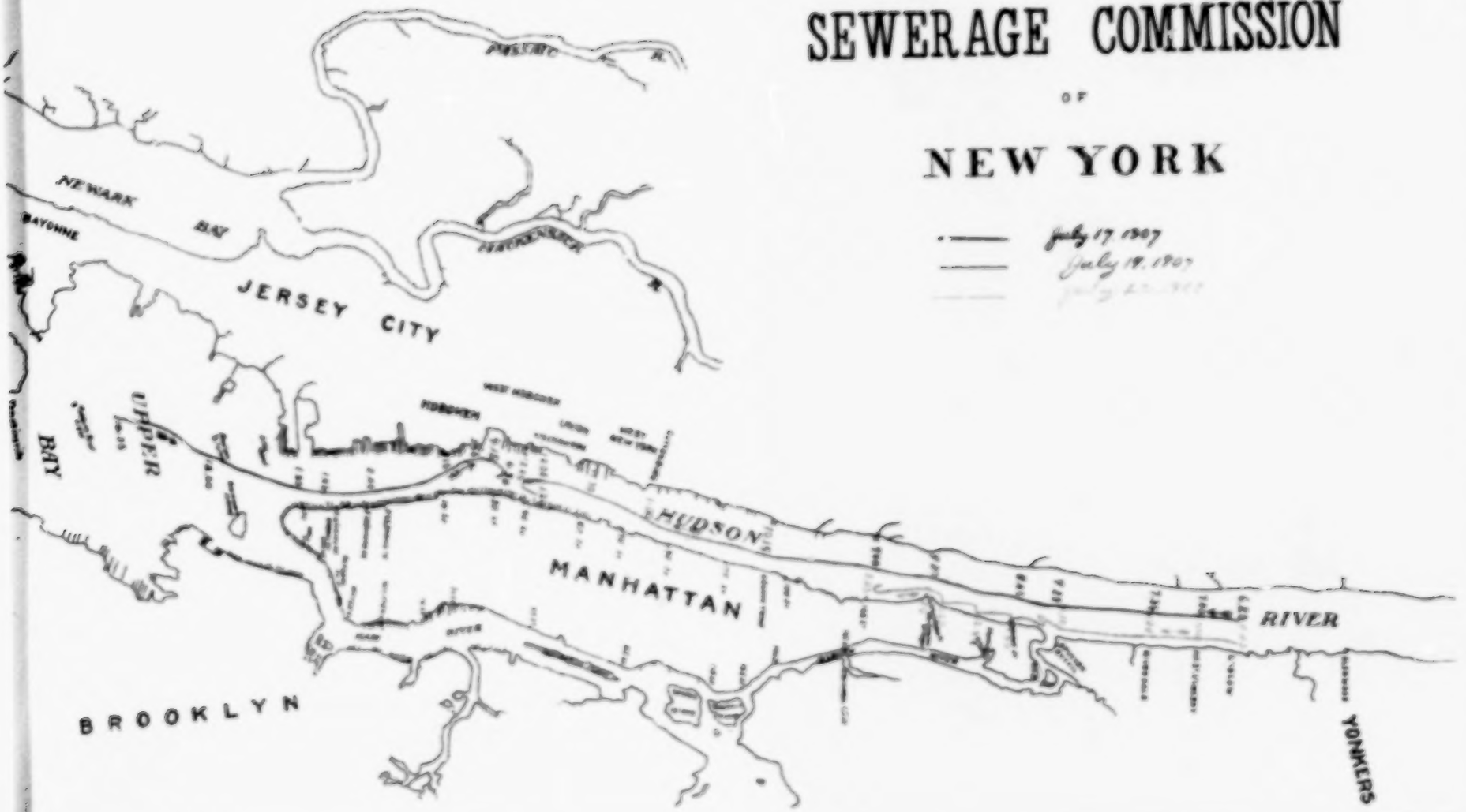
METROPOLITAN SEWERAGE COMMISSION

OF

NEW YORK

July 17, 1907

July 19, 1907



DATA

RELATING TO MUD SAMPLES Nos. 1 to 705

FROM NEW YORK BAY & VICINITY

EXAMINED BY THE METROPOLITAN SEWAGE COMMISSION, 1907

SHEETS 1 to 17 incl.

Complainant's Exhibit No. 14
James L. Maher
Commissioner

1

(1)

Date 1907	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli c.c.	Presumptive B. Coli 1/10 c.c.	Putrescable	Loss on ignition Parts per million by wt.	Color	Odor	Water Temp.	Water Depth	Remarks
Feb 14	1	300' off 51st. Brooklyn	Surface	750 000									
"	2	150' off sewer- 49th St. Bklyn.	"	11000 000									
"	3	Special	"										
"	4	Edge Bay Bridge Chan. 49st.	"	90000									
"	5	Center of Gowanus Bay	"	26000 000									
"	6	Gowanus Canal & 22 st.	"	450 000									
"	7	Battery Slip- Pier A.	"	800000									
Feb. 17	8	Anchorage off Erie Basin	"	370 000									
"	9	" " Gowanus Bay	"	380000									
"	10	" " 49th. St.	"	220 000									
"	11	" " 67th St.	"	460000									
Feb 27	12	Bulkhead - 51st Bklyn.	2'-0"	4000 000				72,080	Black	Sewage	0.5°C.	24 ft.	
"	13	" "	2'-8"	5000 000				69,940	"	Strong "			
"	14	" "	3'-4"	3000 000				46,910	"	Sewage			
"	15	" "	4'-0"	1250 000				25,780	"	"			
"	16	" "	4'-8"	950 000				44.230	"	"			
"	17	Gowanus Canal & Court St.	2'-0"	3000 000				107,403	"	Kerosene	0.75°C.	16 ft.	Torry
"	18	" "	2'-8"	4400 000				99.270	"	"			
"	19	" "	3'-4"	4200 000				107,700	"	"			Much Tar.
"	20	" "	4'-0"	900 000				59.480	"	Sewage & "			Small amount Tar.
"	21	" "	4'-8"	550000				36,250	"	Kerosene			
"	22	Gowanus Canal 300' below Hamilton.	2'-0"	500 000				219,000	"	Strg Coal Tar	0.75°C.	17 ft.	
"	23		2'-8"	950 000				202.400	"	Coal Tar			
"	24		3'-4"	6400 000				183,300	"	" "			
"	25		4'-0"	1650 000				119,300	"	Kerosene			
"	26		4'-8"	900 000				83,790	"	Faint Sewage			
Mol Feb 27	27	Ambrose Channel Lower Bay		2900				59.190	Gray	Odorless		Taken from dredge in 40' water	
Mar. 2.	28	End E. 26 St. Pier E.R. ½ way out.	Surface	950 000				109,000	Black	Faint Sewage		28 ft.	
"	29		"	1700000				204,600	"	" "	2.0°C.	22 ft.	
"	30		2'-0"	850 000				127,100	"	Sew. & Kero.			
"	31		2'-8"	250000				119.200	"	Faint Sewage			
"	32		3'-4"	850000				121,000	"	Aromatic			
"	33		4'-0"	250 000				124.600	"	Sewage			
"	34		4'-8"	250000				108,100	"	"			

* 24ft. = 30ft. 10ft. = 26ft.

(2)

Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli		Putrescible	Loss on Ignition Parts per million by wt.	Color	Odor	Water		Remarks
					I.C.E.	T.C.E.					Temp.	Depth	
Mar. 8	35	Ellis Id. South Slip	Surface	7 700 000				106 100	Black	Sewage	1.0°	15 ft.	
"	36		10"	2 900 000				110 800	"	"			
"	37		18"	3 000 000				108000	"	"			
"	38	Liberty Id. E dock	Surface	2 800 000				99700	"	"		18 ft	
"	39		2'-0"	3 200 000				233900	"	"			Much Tar
"	40		2'-8"	3 000 000				98770	"	"			
"	41		3'-4"	2 800 000				100 000	"	"			
"	42		4'-0"	5 000 000				93 470	"	"			
"	43		4'-8"	2 500 000				110 600	"	"			
Mar. 9	44	East River, foot 24 St.	3'-0"	8 300 000				97 560	"	"		15 ft.	
"	45		3'-8"	4 600 000				106 600	"	Sewage & Refuse			
"	46		4'-4"	1 400 000				101 900	"	" "			
"	47		5'-0"	1 100 000				114 900	"	" "			
"	48		5'-8"	1 200 000				56 860	"	" "			
Mar. 12	49	Blk. Tom Bayonne S. side Nat. Stores	Surface	4 000 000	+	+		137 900	"	" "	0.5° C.	20 ft.	
"	50		0'-4"	2 000 000	+	+		135 900	"	" & gas refuse			
"	51		1'-0"	2 600 000	+	+		172 400	"	" "			
"	52		1'-8"	2 300 000	+	+		190 000	"	" "			Tarry Matter.
"	53		2'-4"	1 900 000	+	+		95 640	"	Sewage			
"	54	Kill von Kull west of Constables Hook	Surface	4 900 000	+	+		102 600	"	Gas refuse			
"	55		2'-0"	2 000 000	+	+		96 160	"	Sewage			
"	56		2'-8"	3 600 000	+	+		98 330	"	"			
"	57		3'-4"	900 000	+	+		87 920	"	"			
"	58		4'-0"	1 900 000	+	+		98 680	"	"			
"	59		4'-8"	3 000 000	+	-		92 130	"	"			
Mar. 15	60	Bet. Ellis & Liberty Id's. 100 yds. from Ellis.	Surface	500 000				68 700	"	Gas refuse	3.0°	10 ft.	
"	61		4'-6"	1 800 000				70 010	D'k. Slate	Fnt. Earthy			
"	62		5'-2"	770 000				56 960	" "	Sewage			
"	63		5'-10"	900 000				59 250	" "	Fnt. Earthy			
"	64		6'-6"	760 000				58 020	" "	" "			
"	65		7'-2"	450 000				56 640	" "	" "			
"	66	Bet. Ellis & Liberty Id's. 1/3 distance from Ellis Id	Surface	930 000				86 150	Black	Gas refuse		8 ft.	
"	67		6'-0"	970 000				72 530	D'k. Slate	Earthy			
"	68		6'-8"	1900000				76000	" "	"			

(3)

Date 1907.	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli		Putrescible	Loss on Ignition Parts per million-by wt.	Color	Odor	Water		Remarks
					.1 C.C.	1 C.C.					Temp.	Depth	
Mr. 15	69	Between Ellis & Liberty Isds. ⅓ dist. from Ellis	7'-4"	2,600,000				73,500	D'k. Slate	Earthy		8 ft.	
"	70		8'-0"	1,500,000				66,800	" "	"			
"	71		8'-8"	500,000				66,050	" "	"			
"	72	Ditto. ⅔ dist. from Ellis.	surface	No count				104,200	Light Slate	sewage		6 ft.	
"	73		5'-0"	1,900,000				72,440	Dark "	earthy			
"	74		5'-8"	1,900,000				68,010	" "	"			
"	75		6'-4"	1,200,000									
"	76		7'-0"	1,600,000									
"	77		7'-8"	1,900,000				66,170	Dark Slate	earthy			
"	78	Ditto. 200 yds. from Liberty Id.	surface	2,800,000				97,600	Black	sewage		6 ft.	
"	79		9'-0"	1,700,000				69,910	Light Slate	earthy			
"	80		9'-8"	1,400,000				56,670	" "	"			
"	81		10'-4"	1,200,000				66,540	Dark "	faint "			
"	82		11'-0"	1,000,000				74,470	" "	" "			
"	83		11'-8"	930,000				68,630	" "	" "			
Mr. 18	84	Back of Ellis Island	surface	800,000				83,150	" "	str'g sewage	2.5°	7 ft	
"	85		5'-0"	1,900,000				69,690	Light "	faint "			
"	86		5'-8"	1,400,000				70,770	" "	" "			
"	87		6'-4"	1,900,000				72,250	" "	" "			
"	88		7'-0"	2,000,000				76,110	" "	" "			
"	89		7'-8"	80,000				74,000	" "	sewage			
"	90	Ditto	surface	30,000				69,900	Black	H_2S "			
"	91	S. of above	3'-6"	118,000				58,870	Light Slate	earthy		8 ft.	
"	92		4'-2"	13,000				57,390	" "	sewage & fishy			
"	93		4'-10"	300,000				58,200	" "	sewage			
"	94		5'-6"	370,000				52,870	" "	"			
"	95		6'-2"	370,000				55,340	" "	faint "			
"	96	Off Jersey between Ellis & Liberty Ids.	surface	1,400,000				60,850	Brown	fishy		6.5 ft.	
"	97		5'-0"	1,800,000				69,830	Light Slate	faint sewage			
"	98		5'-8"	1,300,000				61,000	" "	" "			
"	99		6'-4"	1,800,000				61,960	" "	fishy			
"	100		7'-0"	1,800,000				92,590	Brown	sewage			
"	101		7'-8"	400,000				90,650	Black	Kerosene			
"	90-95	See above	surface to 6'-2"	303,000								8.0 ft.	

(4)

Date 1907	Sample Number	Location	Depth of Sample	Bacteria per gram	Presumptive B. Coli .1cc	Presumptive B. Coli 1cc	Putrescible	Loss on Ignition Parts per million weight	Color	Odor	Water Temp	Water Depth	Remarks
arch 18	96-101	Off Jersey bet. Ellis & Liberty	Surf to 7'6"	Av 1,400,000								6½ ft	
	102-107	" " " " "	" to 8'0"	" 600,000				65,000	Bl.-br.	Kerosene & sewage		6½ ft	
	108-113	" " near Ellis	" to 10'0"	" 600,000				85,000	Brown	sewage		6⅞ ft	
	114-119	Nearer " N of "	" to 6'8"	" 1,200,000				78,600	Bl - brown	strong "		6¾ ft	Surf. putrid
arch 26	120	Off Communipaw	Surf	2,400,000				342,300	Black	" "	2¾°C	9 ft	very "
	121	1000' N of Ellis Island	4'0"	4,300,000				198,400	Light Brown	earthly			tar
	122		4'8"	3,700,000				32,580	" "	"			
	123		5'4"	2,000,000				38,880	Dark "	"			
	124		6'0"	2,900,000				81,560	" "	"			
	125		6'8"	2,300,000				393,000	Light "	sewage			tar
	126-137	300' E. of above	Surf to 15'2" " 2"	Av. 1,000,000 2,800,000				75,000 ±	brown	"		18 ft	
	138-143	250' E " "	" to 10'8"	Av. 1,600,000				82,000 ±	"	Kerosene & "		13 ft	
	144-149	200' E " "	" to 11'2"	" 500,000				90,000 ±	Bl.-Brown	sewage		20 ft	
Total	120 samples in March												
il 1	150-155	100 yards from Black Tom	Surf to 7'6"	½ to 2 mil.				78,000 ±	Dark brown	Kerosene & "	2½°C.	16 ft	
	156-161	Along Bayonne shore	" to 7'6"	½ to 1.8 "				75,000 ±	Brown	" & "		7½ ft.	
	162-167	Off " opp Liberty Id.	" to 7'8"	⅘ to 1.3 "				78,000 ±	"	" & "		6½ ft	
	168-173	" " " Ellis "	" to 5'2"	110,000 to 300,000				25,000 ±	"	" & "		7 ft	
	174-177	" Communipaw	" to 2'0"	800,000 to 1,500,000				80,000 ±	Dark brown	" & "		7½ ft	
5	178-183	" Jersey ½ bet. Liberty & Bl. Tom	" to 6'2"	9/10 to 2.6 mil.				70,000 ±	Bl. brown	gas & "	7°C.	8 ft	
	184-189	" Bay View Cemetery Greenville	" to 5'8"	120,000 to 3 "				90,000 ±	" - "	sewage		12 ft	
	190-195	Bet. last & Pa. R.R. freight Piers	" to 5'8"	110,000 to ½ "				55,000 ±	" - "	"		12 ft	
	196-201	To N of " " " "	" to 4'2"	300,000 to 2 "				40,000 ±	" - "	Kerosene & "		12 ft	
	202-207	Off " " " " "	" to 4'2"	550,000 to 2 "				50,000 ±	" - "	" & "		12 ft.	
11	208-213	Off Bayonne S. of Pa. R.R. " "	" to 6'2"	12,000 to 36,000				65,000 ±	Light brown	" & str. "	4½°c	8½ ft	
	214-219	" " toward Constable Hook	to 8'2"	7,000 to 80,000				60,000 ±	Bl. to "	" & "		7 ft	
	220-225	" " nearer " "	" to 7'8"	6,000 to 55,000				60,000 ±	Bl. to slate	" & "		7 ft.	
	226-231	" N. of " "	" to 9'2"	47,000 to 150,000				60,000 ±	" " "	" & "		7 ft	
	232-237	" Constable Hook nearer Kill-von-Kull	" to 12'8"	4,000 to 117,000				60,000 ±	Black	str. sewage		8 ft	
	238-243	" " " Edge of " "	" to 13'8"	4,500 to 74,000				50,000 ±	Bl. to slate	Keros & "		15 ft	
15	244	Anchorage off Gowanus Bay	Surf	340,000				76,990 ±	Black	Sewage decided	5½°C.	18 ft	
	245		8"	800,000				55,980 ±	"	strong "			
	246		1'4"	270,000				23,310 ±	"	" "			
	247		2'0"	120,000				19,650 ±	Dark brown	Sewage			Sandy

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(5)

Date 1907	Sample No.	Location	Depth of Sample	Bacteria per gram	Presumptive B. Coli 1/10 c.c.	Presumptive B. Coli 1/100 c.c.	Putrescible	Loss on Ignition Parts per m. of Dry matter	Color	Odor	Water Temp.	Water Depth	Remarks
Apr 18	248	Anchorage off 73d Bklyn	Surf.	280,000				34,840	Dark brown	Kerosene	9½°C.	23 ft	Sandy & coal.
	249		8"	270,000				12,150	" "	Sewage "			
	250	150' off 65 St. sewer "	Surf	3,500,000				30,780	Black	" "	12½°C.	18 ft	
	251		8"	1800,000				67,080	"	" "			
	252		1'4"	1500,000				95,750	"	" "			
	253		2'6"	360,000				88,890	"	" "			
	254		2'8"	170,000				67,710	"	" "			
Apr 17	255	Gravesend Bay 100 yds from Marine Dock	Surf.	18,000				17,450	Light Slate	Foul Sewage	8° C.	6 ft	Sandy
	256		2'0"	90,000				26,500	" "	" "			"
	257		2'8"	70,000				58,790	"	decided.			
	258		3'4"	83000				47,103	" "	" "			
	259		4'0"	30,000				53,870	" "	" "			
	260		4'8"	18,000				84890	Black	"			Sandy.
	261	" " 300 ft shore	Surf	45,000				22,280	"	Strong H2S	5°6.	6 ft	
	262	" " Outer end Marine Dock	"	10,000				48,550	Light Slate	Earthy	6°C.	4½ ft	Clean sand.
Apr 19	263	E Side City Dock St George S.I.	Surf	900,000				82,560	Black	Kerosene	6½°C.	9 ft	
	264		6'0"	500,000				61,530	"	"			
	265		6'8"	450,000				54,830	"	"			
	266		7'4"	300,000				72,480	Dark Slate	"			
	267		8'0"	300,000				69,360	Black	"			
	268		8'4"	100,000				54,360	"	Earthy			
	269	S End Pamptonsville S.I.	Surf.	1,500,000				111,100	"	Kerosene	6½°C	9 ft.	
	270		2'10"	600,000				84,000	"	"			
	271		3'6"	500,000				125,200	"	"			
	272		4'2"	300,000				27,130	"	Slight "			
	273		4'10"	450,000				118,000	"	" "			
	274		5'6"	350,000				118,400	"	" "			
	275	S Side near Pier Lower End	Surf.	1,000,000				183,200	"	Strong "	6½°C.	10 ft.	
	276	Shooters Island S.E.	6'8"	400,000				113,600	"	" "			
	277		7'2"	450,000				103,300	"	" "			
	278		7'10"	300,000				102,900	"	" "			
	279		8'8"	200,000				88,980	"	" "			
	280		9'2"	150,000				73,370	"	Slight "			
	281	Foot Slooter Shooters Is	Surf.	1,200,000				105,000	"	Gas rotten	6⅝°C.	10 ft.	

(6)

Date 1907	Sample Number	Location	Depth of Sample	Bacteria per gram	Presumptive B. Coli		Putrescibility	Loss on Ignition Part per mil by weight	Color	Odor	Water		Remarks
					[illegible]	[illegible]					Temp.	Depth	
r 18	282	500' from end of Pier	1'0"	900,000				122,400	black	Kerosene			
	283	½ way in shore	1'8"	700,000				134,280	"	gas			
	284		2'4"	500,000				136,200	"	"			
	285		3'0"	350,000				102,000	"	"			
	286		3'8"	200,000				43,480	"	"			
r 19	287	St. George S.I. Coal Dock	Surf	1,000,000				112,300	"	Kerosene	5½°C	18 ft.	
	288	½ way in shore	4'0"	300,000				140,800	"	"			
	289		4'8"	600,000				100,400	"	"			
	290		5'4"	180,000				115,800	"	"			
	291		6'0"	200,000				118,000	"	"			
	292		6'8"	70,000				110,900	"	"			
	293	Dock New Brighton S.I.	Surf	900,000				58,500	"	"	5½°C	7 ft.	
	294		1'0"	1,650,000				111,700	"	"			
	295		1'8"	800,000				87,883	"	"			
	296		2'4"	1,400,000				78,810	"	"			
	297		3'0"	800,000				108,800	Dark brown	"			
	298		3'8"	400,000				24,480	" "	"			
	299	Dock Sailors Snug Harbor S.I.	Surf	300,000				17,850	Light "	Faint earthy			Fine gravel & sand
	300		8"	500,000				41,760	" "	Strong oil			
	301		1'4"	400,000				28,070	" "	" "			
	302		2'0"	350,000				28,750	" "	" "			
r 26	303	N.R. Cortland 50' from end Pier	Surf	450,000	−	+		87,750	Dark "	Sewage	8½°C	24 ft.	
	304	" Fulton St. ½ end of Pier S.S.	"	900,000	+	+		118,500	Black	"	8½°C	22 ft.	
	305	" Franklin St. 100' from bulkhead	"	800,000	+	+		124,500	"	Kerosene	8½°C	24 ft.	
	306	" Charlton St. ½ end Pier S.S.	"	1,500,000	+	+		112,000	"	" & "	8½°C	26 ft.	
	307	" Gansevoort St. S.S.	"	700,000	+	+		125,400	"	Str. Sewage	8½°C	15 ft.	
	308	" W. 18 St. ½ way in N.S.	"	7,000,000	+	+		141,500	"	" "	8½°C	40 ft.	Very putrid
	309	" W. 30 St. Dump ½ in S.S.	"	18,000,000	+	+		132,800	"	" "	8°C	20 ft.	[illegible] fibres
	310	" W. 39 St. " ½ " S.S.	"	13,000,000	+	+		133,700	"	Sewage gas vapor	8°C	34 ft.	" "
	311	" W. 49 St. S.S.	"	1,000,000	−	+		114,800	"	" " "	8°C	18 ft.	" "
	312	" W. 59 St. S.S.	"	650,000	−	+		131,200	Dark brown	Sewage	8°C	20 ft.	" "
	313	" W. 69 St. S.S.	"	12,000,000	+	+		146,800	" Slate	Str "	8°C.	30 ft.	" "
	314	" W. 79 St. S.S. 100' out	"	3,600,000	+	+		127,500	black	" "	8°C.	20 ft.	" "
Total	127 samples in April												

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(7)

Date 1907	Sample Number	Location	Depth of Sample	Bacteria per gram	Presumptive B. Coli		Putrescible	Loss on Ignition Part per mil by weight	Color	Odor	Water		Remarks
					1/10 C.C.	1 C.C.					Temp.	Depth	
May 10	315	Spuyten Duyvil Great Draw	Surf	268,000 -	–	+		48,880	Dark gray	earthy	10¾°C	20 ft.	
	316	of H. River	6"	28,000 -	–	–		50,660	" "	"			
	317		1'0"	21,000 -	–	–		47,680	" "	"			
	318		2'0"	17,000 -	–	–		47,690	" "	"			
	319		3'0"	3,000 -	–	–		48,700	" "	"			
	320		4'0"	8,000 -	–	–		50,000	" "	"			
	321	Ditto at Bwy opp. Johnson's mach. shop	Surf.	580,000	+	+		164,100	black	Str. & oil	11½°C.	6 ft.	
May 18	328	Har. Riv. 100' S. of Bridge at Kingsbridge W. Shore	Surf	450,000	+	+		34,240	"	Sewage			Coarse sand
	329		1'0"	300,000	+	+		58,180	"	Str. "			
	330		2'0"	1,300,000	+	+		814,600	"	— "			Decol. bay.
	331	Harlem Riv. foot W. 217 St.	Surf	900,000	+	+		48,610	dark brown	" "	11°C.	10 ft	Sandy
	332		1'0"	400,000	+	+		41,480	" "	" "			
	333		2'0"	800,000	+	+		61,750	" "	"			
	334		3'0"	350,000	–	+		36,480	" "	"			
	335		4'0"	250,000	–	+		53,870	" "	"			
	336	" " W. 207 St. 100' N. of Bridge	Surf.	700,000	+	+		61,780	" "	"	11°C.	8 ft.	
	337		1'0"	700,000	–	+		108,600	black	"			
	338		2'0"	400,000	+	+		92,420	dark brown	"			
	339		3'0"	300,000	–	–		93,900	" "	faint "			
	340		4'0"	800,000	–	–		103,400	" gray	" "			
	341		5'0"	400,000	–	+		97,150	" "	" "			
	342	" " opp. Morris Hts. 100' from W. shore.	Surf	800,000	+	+		104,600	black	Sewage & gas refuse	11°C	6 ft.	
	343		1'0"	200,000	+	+		50,880	dark brown	"			
	344		2'0"	250,000	+	+		89,830	" "	"			
	345		3'0"	300,000	+	+		109,100	" "	foul gas			
	346		4'0"	250,000	–	+		73,560	" "	" " & oil			
	347		5'0"	250,000	–	–		195,100	" "	" " & "			
	348	" " under Mack. Bridge E. Shore	Surf	1,000,000	+	+		111,500	black	Kerosene	11¼°C	4 ft.	
	349		1'0"	500,000	+	+		120,000	"	Str. "			
	350		2'0"	400,000	+	+		115,300	"	" "			
	351		3'0"	300,000	+	+		141,900	"	" Sewage			
	352		4'0"	400,000	+	+		91,810	dark brown	Ker. & Sew.			
	353		5'0"	300,000	–	+		108,400	" "	" & "			
	354		6'0"	200,000	+	+		85,120	black	" & "			

Ex. 16-P.7

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Date 1907	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B.Coli .1 C.C.	Presumptive B.Coli 1 C.C.	Putrescible	Loss on Ignition Part per mil. by weight	Color	Odor	Water Temp.	Water Depth	Remarks.
May 13	355	Har. Rir. under High Bridge E. Shore	Surf	700,000	+	+		76,720	dark brown	faint earthy	11 1/4 °C	6 ft.	
	356		1'-0"	400,000	-	+		82,830	Light "	" "			
	357		2'0"	350,000	-	-		78,840	" "	" "			
	358-362	" " opp 165 St E Shore	Surf to 4'-0"	N. 250,000	+	+		100,000+	bl dark gray	Sewage	11 1/2 °C	4 ft.	
May 14	363-368	" " Putnam R.R. Br. N. "	" to 5'-0"	100,000 to 700,000	+	+		95,000±	bl. light	" Steres	12°	2 ft.	
	369-374	" " Below N.Y. Central Br.	" to 5'-0"	200,000 to 400,000	+	+		95,000±	bl-dark br.	" "	12°	2 ft.	
	375-381	" " foot W. 143 St	" to 6'-0"	200,000 to 2,000,000	+	+	yes	145,000±	black "	" "		12 ft.	
	382-384	" " Mod Av. Bridge	" to 2'-0"	250,000 to 400,000	+	+		142,800	" to gray	gas refuse	13°	12 ft.	
	385-391	" " foot 153 St W. Shore	" to 6'0"	600,000 to 2,200,000	+	+		132,700	" to brown	H2S gas	13°	8 ft.	putrid
	392-395	" " Randalls Id. Pier	" to 3'-0"	350,000 to 2,000,000	+	+	yes	186,500	black	Sewage "		6 ft.	putrid
	396-399	N.Y. Bay Back of Ellis Id.	" to 3'-0"	400,000 to 1,800,000	+	+		89,840	" to gray	earthy	11° C	20 ft.	
May 15	400	Hoctel Dock above N.Y.C. R.R.	Surf	2,100,000	+	+		113,800	black	sew & gas			
	401	Jersey City	1'-0"	1,300,000	+	+		125,000	dark br.	Str. earthy			
	402		2'0"	600,000	+	+		81,750	"	Sewage "			
	403		3'0"	700,000	+	+		118,800	"	"			
	404		4'-0"	600,000	+	+		113,800	"	Str. moldy			
	405		5'0"	300,000	+	+		102,400	" gray	" Sewage			
May 22	406	Gravesend Bay 300's Marine Basin	Surf	300,000	+	+		90,060	Light "	"	17°6.	6 ft.	Corse Sand
	407	" " near Coney Id. Creek	"	350,000	+	+		70,920	dark brown	H_2S	17°C.	5 ft.	Sand
	408	" " entrance to Coney Id. Creek	"	800,000	+	+		93,240	" "	"	17°C.	5 ft.	Sand
	409	Coney Id. Creek near mouth	"	1,200,000	+	+		23,960	black	"	18°C.	6 ft.	"
	410	" " " " "	1'-0"	1,500,000	+	+		42,180	"	"	19°C.	6 ft.	"
May 23	411	Slip Conover St. Brklyn	Surf.	700,000	+	+		34,830	"	Sewage	19°C.	6 ft.	"
	412		1'-0"	3,000,000	+	+		104,500	"	"			
	413		2'-0"	3,000,000	+	+		124,700	"	Str. "			
	414		3'-0"	3,200,000	+	+		127,800	"	"			
	415		4'-0"	2,800,000	+	+		116,500	"	"			
	416		5'-0"	1,110,000	+	+		78,200	"	"			
	417	Slip Sedjmck St. "	Surf.	6,000,000	+	+		142,900	"	Sewage "	19°C.	16 ft.	
	418		1'-0"	7,700,000	+	+		165,200	"	Sewage "			
	419		2'-0"	4,000,000	+	+		153,500	"	" & "			
	420		3'-0"	3,000,000	+	+		143,100	dark brown	Str. mouldy			
	421		4'0"	2,500,000	+	+		158,100	black	" "			
	422	Slip Stole St. "	Surf.	9,500,000	+	-		176,300	"	earthy & gas	19°C.	12 ft.	

Ex. 14-P 8

(9)

Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B Coli. I.C.C.	Presumptive B Coli. N.E.	Putrescible	Loss on Ignition Parts per mil. by weight	Color	Odor	Water Temp.	Water Depth	Remarks.
May 23	423		1'-0"	12,000,000	+	+		174.300	Black	earthy			
	424		2'-0"	5,400,000	+	+		182,800	"	"			straw
	425		3'-0"	4,800,000	+	+		187.600	Light brown	& gas			
	426		4'-0"	4,300,000	+	+		186,800	black	"			
	427		5'-0"	4,400,000	+	+		135.200	Light brown	"			veg. fibres.
	428		6'-0"	1,600,000	+	+		234,200	black	"			
	429	Slip Clark St. Bkfst	surf.	19,000,000	+	+		232.400	"	"	19°C	25 ft.	Wood
	430		1'-0"	8,000,000	+	+		167.900	Light brown	" & "			
	431		2'-0"	7,000,000	+	+		214,600	" "	" & "			
	432		3'-0"	5,400,000	+	+		151,500	" "	earthy			
	433		4'-0"	3,800,000	+	+		133.100	" "	"			
May 29	434	E.R. 47 St. Slip Bkfst ooze	surf	5,800,000	+	+		181,800	black	very putrid	12°C.	1/4 ft.	
	435	" " middle opp 47 St. Brown sand	"	200,000	−	−		11,070	Light brown	fish	11½°C.	90 ft.	coarse sand
	436	" " 42 St. Slip Bkfst ooze	"	6,000,000	+	+		92.290	black	very putrid	13°C.	14 ft.	
	437	" " 62 St. Slip, 20' from shore Bkfst. ooze	"	15,000,000	+	+		166,000	"	" " & gas	13°C.	17 ft.	straw
	438	" " 62 St. Pier 20' from shore Bkfst. ooze	"	18,000,000	+	+		104,000	"	" " & "	13°C.	30 ft.	
	439	" " middle opp 35 St. brown sand	"	400,000	−	−		166,700	Light brown	faint sew.	13°C.	30 ft.	Sand
	440	" " anchorage off 26 St. brown sand & gravel	"	700,000	−	−		—	—	odorless	13°C.	30 ft.	
Total	126 Samples in May												
June 4	441	Slip W. 50 St. inner end	surf	4,200,000	−	+	Yes	96.650	black	sewage	18½°C.	10½ ft.	
	442	" " Pier head	"	3,400,000	+	+	"	150.100	"	" & gas	18°C.	30 ft.	strongly putrescible
	443	300' off " "	"	2,700,000	+	+	"	133.900	"	" & "	18°C.	35 ft.	
	444	500' " " "	"	700,000	−	+		—	dark gray	earthy	18°C.	40 ft.	coal & ashes
	445	midstream off 50 St.	"	300,000	+	+		112.700	black	sew & gas	18°C.	45 ft.	paper pulp
	446	" " 42 St. N. River	"	200,000	−	+		60.760	dark gray	earthy	18°C.	40 ft.	
	447	" " 34 " " "	"	150,000	+	+		—	—	—	18°C.	40 ft.	very small shells
	448	" " 23 " " "	"	200,000	+	+		89.500	black	mouldy	18°C.	40 ft	
	449	" " 14 " " "	"	180,000	+	+		98.260	"	str. sewage	18°C.	60 ft	strongly putrescible
	450	" " Houston " "	"	220,000	+	+		91.850	gray	earthy	18°C.	60 ft.	coal & ashes
	451	" " Pier "O" " "	"	350,000	+	+		119.800	black	strong sew.	18°C.	45 ft	fine ooze
June 5	452	Anchorage of Erie Basin	"	800,000	+	+		27.670	dark brown	" "	18°C.	25 ft.	" sand mica scales
	453	" " Gowanus Bay	"	400,000	+	+		88.430	black	" H_2S	18°C.	35 ft	" " many shells
	454	" " 39 St. Bkfst	"	400,000	+	+		125.200	"	" sewage	18°C.	30 ft.	" " " "
	455	" " 53 St. "	"	300,000	+	+		86.860	"	" "	19°C.	25 ft.	very putrid

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Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli .1 c.c.	Presumptive B. Coli 1 c.c.	Putrescible	Loss on Ignition Parts per mil. by weight	Color	Odor	Water Temp.	Water Depth	Remarks
June 5	456	Anchorage off 67 St. B'klyn.	surf	200,000	+	+		31,270	black	strong sew	18° C.	30 ft.	ashes, coal sand, shells
	457	" " 72 " "	"	95,000	+	+		45,880	"	" H_2S	18° C.	40 ft.	ooze, sand & wood
	458	" " 79 " "	"	100,000	+	+		350,400	"	gas refuse	18° C.	40 ft.	
	459	" " 92 " "	"	85,000	+	+		19600	dark grey	sewage	18° C	35 ft	shell fragments gravel & coal
	460	" " middle of Narrows opp Ft Ham	"	80,000	+	+		31,120	" brown	"	18° C.	60 ft.	sandy
June 6	461	Slip 10 St. E. River Sat. with oil from gas works	"	3,200,000	+	+	Yes	—	—		17½° C.	12 ft.	
	462	" 23 St. " " S.S. Recreation Pier	"	1200,000	+	+	" & bubbles	—	—		18° C.	15 ft.	
	463	midstream opp 42 St. E. River	"	25,000	—	—		14,340	Light brown	mouldy			coarse sand
	464	Newtown Cr. above Meeker Av. Br. Sat. with oil from S.O. Refineries	"	4,000,000	+	+	"	260,000	black	gas & H_2S			very putrid
June 12	465	Slip 10 St. E. Riv. inner end	"	240,000	+	+		241,000	"	sewage	14½° C.	12 ft.	oily ooze very putrid
	466	" " " " pier head	"	120,000	+	+		158,800	"	"	14° C.	20 ft.	" " " "
	467	50' off " " "	"	200,000	+	+		43,940	—	Str. mouldy	14° C.	30 ft.	coarse sand & gravel Terry mat.
	468	Slip 12 St. E.R. inner end	"	130,000	+	+		202,400	black	" tarry	14½° C.	12 ft.	black ooze
	469	" 13 " " " "	"	500,000	+	+		249,200	"	" sewage	14½° C.	12 ft.	veg. fibres & Terry mat.
	470	" " " pier head	"	9,500	0	0		58,470	Light yellow	H_2S	14½° C.	20 ft.	clay
	471	" 22 St. E.R. inner end	"	170,000	+	+		206,400	black	tarry	14½° C.	30 ft.	ooze, fiberous
	472	" " " " pier head	"	100,000	0	0		120,000	"	Str. Sewage	14½° C.	30 ft.	ooze
	473	" 61 St. E.R. inner end	"	57,000	+	+		139,800	"	" "	14½° C.	23 ft.	ooze very putrid
	474	" 42 St. " " "		309,000	+	+		100,530	"	" mouldy	14½° C	20 ft.	bl ooze & gravel
	475	" 9 St. " pier head		69,000	+	+		103,000	"	sew. & H_2S.	14½° C	20 ft.	" " & coal

N.B.

Gas works 9th - 13th Sts., 22d St., 42nd & 61st Sts. Samples taken in these slips were all black oily ooze with a strong odor of tar & illum. gas except #470 which was clay like consistency, color of terra cotta. When dry had no odor. Black ooze from 23rd St. Slip had several million bacteria per gram. That from 22nd St. where gas waste was plentiful only 170,000.

Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli .1 c.c.	Presumptive B. Coli 1 c.c.	Putrescible	Loss on Ignition Parts per mil. by weight	Color	Odor	Water Temp.	Water Depth	Remarks
June 17	476	Newton Cr. Met Av. Br. only ooze	surf.	3,000,000	+	+	Yes	205,430	black	burnt rubber	17½° C.	10 ft.	Putrescible oily ooze
	477	" " Montrose Av. " "	"	1,500,000	+	+	"	209,650	"	gas odor	17½° C.	12 ft.	oily green mould putrescible oily ooze
	478	" " Meeker Av. Br. " mud	"	1,500,000	+	+	"	158,200	"	" " very strong	17½° C.	4 ft.	" oily mud "
	479	" " 1000' above Greenpoint Av. B'klyn S.S.	"	500,000	?	?	"	239,570	"	gas odo. very strong	17½° C.	15 ft.	" Terry matter "
	480	" " 500' " " "	"	1,000,000	0	0	"	100,500	Yellow	burnt rubber	17½° C.	15 ft.	clay
	481	" " 50' below " " " S.S.	"	5,000,000	+	+	"	44,193	black	Str. gas	17½° C.	15 ft.	Oily
	482	" " Vernon Av. Bridge	"	50,000	0	0		44,610	"	H_2S	17½° C.	15 ft.	coal & ashes
	483	" " 500' below " "	"	2,900,000	0	0		106,770	grey	mouldy	17½° C.	15 ft.	oily sand sand, gravel, ashes, grain
	484	" " middle of mouth	"	1,000,000	+	+		62,460	brown	"	16½° C.	30 ft.	oily sand Clay
	485	E. Riv. 500' off Newtown Cr.	"	2,000,000	+	+		33,945	"	"	16½° C.	50 ft.	oily sand ashes, oats, tarry matter
June 18	486	Wallabout Bay N.S. foot John St.	"	1,300,000	+	+	Yes	66,580	"	"	16½° C.	40 ft.	fine sand gas works

RSK

Ex. 14 - P. 10

(11)

Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli N.C.C.	Presumptive B. Coli I.C.C.	Putrescible	Loss on Ignition part per mil. of [illegible]	Color	Odor	Water Temp.	Water Depth	Remarks
June 18	487	Wallabout Bay E.S. foot Cross St.	Surf	2,500,000	+	+	Yes	251,590	black	Str. gas	17½°C.	20 ft.	black muck, muck oil
	488	" " E.S. " Division	"	4,000,000	+	+	"	326,300	dark brown	" mouldy	17½°C	25 ft	moulds & oil
	489	" " near Wallabout mar[ket]	"	25,000,000	0	0	"	239,983	"	faint sewage	17½°C	20 ft	veg. fibres
	490	" creek upper end	"	11,000,000	+	+	"	203,550	black	H_2S	17½°C	15 ft.	muck & clay
	491	" " Wash. Ave. Bridge	"	25,000,000	0	0	"	240,400	dark brown	Str. sewage	17½°C.	15 ft	grain &c
June 26	493	500 N.E. Robbins Reef N.Y. Bay	"	500,000	+	+		101,500	grey	very " "	19°C	35 ft.	clay
June 26	494	1 mile N. St George S.I. " "	"	220,000	+	+		63,600	"	sewage	19°C.	35 ft	
	495	1000' off South Beach S.I. " "	"	50,000	–	–		35,590	black	gas	19°C.	6 ft	muck & many shells
June 21	496	midstream off 72 St. N. River	"	1,000,000	+	+		72,810	grey	earthy	18½°C	50 ft.	
	497	Spuyten Duyvil Cr. Draw Br. of mouth	"	180,000	0	0		58,160	"	weedy	19°C	18 ft.	
	498	Harlem River midstream 100 ft below Kings Br.	"	360,000	+	+		150,380	" & red	Str. sewage	19°C.	18 ft.	clays
	499	" " " under	"	230,000	+	+		53,490	—	slight fishy	19°C.	20 ft	coars sand
	500	" " " 215 St.	"	140,000	+	+		6,379	—	" earthy	19°C	20 ft.	clean " "
	501	" " " Dikeman St.	"	800,000	+	+		14,840	dark grey	gas	19°C.	20 ft	fine sand & mud
	502	" " " High bridge	"	100,000	–	+		3,366	dark grey	odorless	19°C.	20 ft.	sand
Total	samples	62 in June	"										
	503	Gas Buoy #2 N.E. Robbins Reef	"	15,000				22,000	—	Str. sewage	22°C.	50 ft.	fine gravel & shells
	503-513	Stapleton 100' off New dock	"	45,000				44,030	Red	gas & "		40 ft.	red clay
	505	500' off upper Quarantine dock	"	370,000				102,400	black	str. H_2S		60 ft.	muck very putrid
	506	Narrows, off Ft. Wadsworth	"	40,000				59,680	"	sew & gas		60 ft	clay " "
	507	Ball Buoy just outside Narrows	"	150,000				52,590	"	"		60 ft	" "
	508	200' E. Buoy #13 Lower Bay	"	60,000				31,190	dark brown	Str. mouldy		50 ft	"
	509	700' E. Hoffman Id. " "	"	43,000				28,840	black	sew. & gas		50 ft.	shells, gravel, sand very bad odor
	510	1000' farther out " "	"	7,500				6,794	brown	none		60 ft.	" clean sand
	511	200' E. off Spiles N.E. Hoffman Id.	"	60,000				78,710	black	sew & gas		50 ft	very bad looking muck
	512	500' S.E. Buoy #13 outer end Narrows	"	220,000				83,370	"	" & "		60 ft	
	513	Narrows opp. Ft. Wadsworth	"	79,000				39,080	"	H_2S & gas		60 ft.	putrid
	514	#2 gas Buoy off Pa. R.R. Sagamore	"	150,000				57,910	"	sewage	22°		oil muck & sand
	515	1000 ± ft. north of above	"	160,000				95,630	"	H_2S & "	22°		" & clay
	516	2000 ± ft. S. of Liberty Id.	"	350,000				177,480	"	Creosote	"		" fibres
	517	Blk. buoy 500' S. " "	"	650,000				14,800	"	str. H_2S	"		" & clay
	518	200' S. E. " "	"	540,000				38,570	"	" gas			" & sea shells
	519	main channel W.S. opp. " "	"	60,000				41,110	"	faint sewage gas			sand coal ashes
	520	" " center " " "	"	100,000				124,200	"	str. gas			stone & coal

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Ex. 14 - P. 11

(12)

Date 1907	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B coli .1 C.C.	Presumptive B coli 1.0 C.C.	Putrescible	Loss on Ignition Parts per milligram	Color	Odor	Water Temp.	Water Depth	Remarks.
July 16	521	main channel U.S. opp Liberty Surf	Surf	4,400,000				34,850	black	gas			mud, ashes, coal
	523	" " opp Atl. Basin Buoy	"	120,000				88,030	"	H_2S			mud, green mould
	523	" " " Erie "	"	100,000				65,520	"	Str. "			" quite putrid
	524	" " " " -500' "	"	80,000				89,120	dark brown	gas			" & clay
	525	" " " Governors	"	1,000,000				84,830	Black	slight sew			" & green mould
	526	" " " 39th St. Bklyn	"	1,800,000				25,960	"	gas			" & sand
	527	" " " 53 " "	"	700,000				10,620	dark brown	"			" & ashes
	528	E. anchorage opp 53 St. Bklyn	"	3,400,000				39,500	Black	Str. Sewage			" & sand
July 17	529	12 gas Buoy Liberty 67 ft.	"	550,000				52,260	"	gas & "	82°		" ashes, shells
	530	" " " " Constable Hook	"	6,000,000				83,370	brown	Str. mouldy			clay, odor strong
	531	500' N.E. of above	"	2,500,000				31,130	Black	very Str. H_2S			much shells, ashes
	532	Short dist N.E. of above	"	300,000				41,970	"	Sewage			" " "
	533	main channel S.E. of Liberty 1st	"	300,000				55,630	dark brown	" "			" " "
	534	" " 500' NE of above	"	120,000				149,060	" "	Str. "			" coal very putrid
	535	" " Bet Ellis, Governors Is.	"	110,000				104,030	" "	" "			" " ashes very putrid
	536	1000' off Pier 7 North River	"	150,000				69,380	Black	" mouldy			ashes & cinders
	537	600 " " 23 " "	"	190,000				42,600	brown	"			" & "
	538	300' " " 42 " "	"	60,000				61,312	Black	H_2S			much & coal
	539	midstream opp. 27 St. " "	"	70,000				41,140	"	" & mouldy			chiefly ashes
July 18	540	N. Riv. opp Mt. St. Vincent	"	100,000	0	+		73,390	dark grey	faint sew.			fine mud
	541	" " " Riverdale	"	230,000	0	+		80,900	Black	Str. H_2S			much & clay
	542	" " " Spuyten Duyvil R.R.	"	200,000	+	+		78,530	"	" "			" & "
	543	" " " " Brew Bridge	"	260,000	+	+		85,450	"	sew & "			" & "
	544	" " " Inwood	"	300,000	+	+		73,390	"	" & "			" & "
	545	1/2 out N.J. Shore Weehawken	"	290,000	+	+		75,190	"	" & "			" & "
	546	1/2 " " " " "	"	1,200,000	+	+		101,760	dark grey	Str. mouldy			clay
	547	midstream N.E. opp W. 6 St.	"	800,000	+	+		77,180	brown	Sewage			much & "
	548	1/2 out N.J. Shore " " 133 "	"	1,200,000	+	+		86,110	grey	sewage			"
	549	midstream " " " 123 "	"	2,300,000	+	+		98,050	dark "	Str. mouldy			"
	550	" " " " 108 "	"	650,000	+	+		70,100	" "	"			"
	551	" " " " 93 "	"	800,000	+	+		83,970	" "	Sewage			ashes & cinders
	552	" " " " 80 "	"	400,000	+	+		61,090	Black	gas			" & coal
	553	" " " " 68 "	"	1,600,000	+	+		81,570	"	very Str. Sew			mud & cinders
	554	" " " " 48 "	"	230,000	+	+		53,070	dark grey	faint Sew			" & clay

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(15)

St. No.	Sample Number	Location	Depth of Sample	Bacteria per gram	Presumptive B. Coli 1 c.c.	Presumptive B. Coli .1 c.c.	Putrescible	Loss on Ignition Parts per million dry weight	Color	Odor	Water Temp.	Water Depth	Remarks
[illegible]	555	N. Riv. 400' off Sugar House Dock Yonkers	Surf	110,000	+	+		69,010	brown	str. sewage	23½°		mud & clay
	556	" " 200' " Fernbrook [illegible]	"	170,000	+	+		89,610	black	" "			" & glass
	557	" " 200' " Bathing beach "	"	200,000	+	+		80,181	"	" "			" & clay
	558	" " 150 " 181 St. [illegible]	"	190,000	+	−		82,280	"	" "			mud, coal ashes
	559	" " 100' " Riverdale R.R. dep.	"	190,000	+	+			—	none			shells & clean mud
	560	" " 150' " R.R. Tower	"	422,000	+	+		62,850	black	str. sewage			mud & clay
	561	" " 100' " Spuyten Duyvil draw	"	360,000	+	+		42,910	dark br.	str. sewage			" "
	562	" " 50' Inwood Dock	"	1,000,000	+	+		42,616	black	H_2S & "			" & ashes
	563	" " 150' off [illegible]	"	550,000	+	+		53,000	dark br.	" & "			" & fine sand
	564	" " 1500' " 187 St.	"	360,000	+	+		34,030	" "	very str. "			" & clay
	565	" " 500' W. 167 St.	"	410,000	+	+		42,810	" "	slight "			" & ashes
	566	" " 1000' opp. 155 St.	"	850,000	+	+		53,100	" "	" "			sand & clay
[illegible]	567	E. Riv. 800' off Jamaica Ave. [illegible]	"	390,000	−	+		60,530	black	str. gas	20°		mud, ashes, sand, tar paper
	568	" " 200' " "	"	180,000	−	+							
	569	" " 150' " Temple St. [illegible]	"	390,000	−	+							
	570	" " foot of Main St. "	"	456,000	−	+							
	571	" " " " B'way Astoria	"	300,000	−	+							
	572	" " S. End Blackwells Id. E. channel	"	59000	0	+							
	573	150' up Standard oil [illegible]	"	1,800,000	−	+							
	574	E. channel opp. E. [illegible] St.	"	179,000	0	+							
[illegible]	575	Outer Bay near [illegible] light		46,000	0	+							
	576	" " " Elm Tree Beacon	"	64000	0	+							
	577	" " [illegible] " " "	"	48,000	0	+							
	578	" " near old Orchard light	"	22000	+	+							
	579	Midway bet. [illegible] & Elm Tree	"	38,000	0	+							
	580	" " off Elm Tree Beacon	"	40,000	0	+							
	581	" " W. off Swinburn Id.	"	58000	0	+							
	582	" S. off " "	"	26000	0	+							
	583	Pier head Happy Land St.	"	38,000	0	+							
[illegible]	584	Buttermilk channel bet. Gov. Id. & B'klyn	"	54000		+					20½°C		Sand & gravel
	585	E. Riv. opp. Gov. Id.	"	62,000		+							" & "
	586	Upper bay E. off Robbins Reef	"	380000	+	+							
	587	Narrows opp. Ft. Hamilton	"	1,009,000	+	+	Yes						
	588	Outer end E. Anchorage	"	2,000,000	+	+	—						

Ex. 14 - P. 13

(14)

	Sample number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli .1 C.C.	Presumptive B. Coli 1 C.C.	Putrescible	Loss on Ignition parts per million	Color	Odor	Hole Temp.	Hole Depth	Remarks.
[illegible]	589	by Spile buoy Half last.	Surf	1,400,000	+	+	Yes						
	590	Anchorage S. of "	"	1,300,000	+	+	"						
	591	" S of Robbins Reef Light	"	1,400,000	+	+	"						
	592	" E. " " " "	"	1,100,000	+	+	"						
	593	" near bell buoy	"	1,000,000	+	+	"						
	594	" opp 53 St	"	1,300,000	+	+	"						
	595	see chart	"	860,000	+	+	"						
	596	Anchorage off Gowanus	"	3,000,000	+	+	"						
	597	" " Erie Basin	"	3,400,000	+	+	"						
	598	" " 53 St.	"	6,000,000	+	+	"						
	599	" E. of last	"	3,000,000	+	+	"						
	600	" near B'klyn shore	"	4,300,000	+	+	"						
	601	see chart	"	4,000,000	+	+	"						
	602	" "	"	3,300,000	+	+	"						
	603	" "	"	1,700,000	+	+	"						
	604	" "	"	1,900,000	+	+	"						
	605	" "	"	3,000,000	+	+	"						
	606	" "	"	1,900,000	+	+	"						
	607	" "	"	3,700,000	+	+	"						
	608	" "	"	3,500,000	+	+	"						
	609	" "	"	4,000,000	+	+	"						
	610	" "	"	3,300,000	+	+	"						
	611	" "	"	3,200,000	+	+	"						
	612	" "	"	3,000,000	+	+	"						
	613	about 1500 ft S.W. of Pier 45 (1st Pier N of Beard Erie Basin)	"	2,000,000	+	+	"						
	614	" "	"	1,900,000	+	+	"						
	615	" "	"	4,400,000	+	+	"						
	616	" "	"	5,400,000	+	+	"						
	617	" "	"	2,400,000	+	+	"						
	618	½ way bet. S.end Gov. Isl & B'klyn	"	2,500,000	+	+	"						
	619	" " " Castle " " " & 600 [illegible] from shore	"	4,600,000	+	+	"						
Total Samples 117 in July			"										
[illegible]	620	Ambrose channel 900' S.E. [illegible] buoy	"	240,000								35 ft.	sample taken from dredge
	621	" " " " "	Deep	110,000								35 ft.	

Ex. 14 - P. 14

(15)

Date 1907	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli 1 c.c.	Presumptive B. Coli 1/10 c.c.	Putrescible	Loss on Ignition parts per mil by weight	Color	Odor	Water Temp.	Water Depth	Remarks.
Aug 21	622	Ambrose Channel 200' S.E. 90S buoy	Deep	2,800								35 ft.	
	623	" " 200' S " " #4	Surf.	1,600,000	+	+						26 ft.	Samples taken from dredge
	624	Edge " 50' N of Some Ann " #2	"	54,000								18 ft.	
	625	Edge " " " "	"	350,000	+	+						28 ft.	mud mud bottom
Aug 30	626-636	Ambrose Channel 11 samples	"		-	+	Not						
		taken in 35°-44' water from Swinburn Jd.											
		to 90S buoy #2 gore N.W. of		17,300									
		all of these locations previously dredged											
	637-639	3 samples taken in 32°-34' water on			+	+	Yes						
		edge or just outside of channel											
		gore		1,670,000									
		Note says decomposed garbage dumped here.											
		Bed of channel now clean sand - above 3											
		samples taken from black mud on edge											
		may have been moved by dredges -											
		No exam could be made of shoals											
		away from channel as boat draw											
		13 ft.											
Total	Samples	20 in August.											
Sept 3	640	Hollabout Bay from Division	Surf	5,700,000			Yes				23°	15 ft.	
	641	" " " Cross St	"	3,800,000			"					15 ft.	
	642	" " of Market	"	5,100,000			"					15 ft.	
	643	All Basin foot Conal St.	"	4,000,000			"					30 ft.	
	644	" " " William St.	"	2,800,000			"					30 ft.	
	645	" " " Commerce St.	"	3,100,000			"					26 ft.	
	646	Erie " S.W. Cor.	"	1,600,000			"					25 ft.	
	647	" " N.E. "	"	4,000,000			"					22 ft.	
Sept 4	648	Coney Id. Creek mouth	"	3,800,000			"				23°	8 ft.	
	649	Gravesend Bay midway bet. Yacht Club & C.I. Creek	"	600,000			"					6 ft.	
	650	" " 200' off Yacht Club	"	150,000			Not					6 ft.	
	651	Gowanus " center	"	13,000,000			Yes					30 ft.	
	652	" Canal " 300' below Hamilton Ave	"	5,000,000			"					21 ft.	
	653	" " pool 20 St.	"	11,000,000			"					24 ft.	
Sept 5	654	Kill Van Kull 50' off New Brighton	"	3,900,000			"					15 ft.	

Ex. 14 - P. 15

(16)

...le ...07	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli .1cc	Presumptive B. Coli 1cc	Putrescible	Loss on Ignition parts per mil. by weight	Color	Odor	Water Temp	Water Depth	Remarks.
...t.5	655	...il Fon Eal 50' from Consolidate H.	Surf	2,500,000			yes					5 ft.	
...6	656	Harl. Riv. bet. 3 & 4 Av. 50' from S.S.	"	3,300,000			"				23½°C.	12 ft.	
	657	" " " 3 & 4 " midstream	"	4,000,000			"					22 ft.	
	658	" " " 3 & 4 - 50' from N.S.	"	3,400,000			"					21 ft.	
...10	659	Narrows 300' off Ft. Hamilton	"	500,000			"				22½°	10 ft.	
...11	660	Newtown Cr. Johnson & Morgan Av.	"	2,700,000			"				22½°	15 ft.	
	661	" " Metrop. Ave. Bridge	"	1,800,000			"					16 ft.	
	662	" " Maspeth " "	"	2,200,000			"					20 ft.	
	663	" " Meeker " "	"	2,000,000			"					19 ft.	
	664	" " Greenpoint " "	"	1,300,000			"					17 ft.	
...18	665	Har. Riv. Pier head N.W. ... Randall's Id.	"	4,400,000			"					5 ft.	
	666	" " midway bet. 2 & 3 Av. Bridges	"	5,000,000			"					22 ft.	
	667	" " " " 4 & Mad. Av. "	"	4,800,000			"					22 ft.	
	668	" " " " 145 & 155 sts.	"	2,700,000			"					21 ft.	
	669	" " foot Dikeman St.	"	1,900,000			"					17 ft.	
	670	" " Kingsbridge	"	1,200,000			"					19 ft.	
...25	671	Newark Bay off Shooters Id.	"	700,000	+	+	"				22½°	30 ft.	
	672	" " " Centerville	"	80,000	o	+	not					22 ft.	
	673	" " " Buoy #4	"	1,200,000	+	+	yes					12 ft.	
	674	" " " " #11	"	1,700,000	+	+	"					15 ft.	
	675	Passaic River at mouth	"	2,000,000	+	+	"					8 ft.	
...26	676	North River Spuyten Duyvil	"	86,000	+	+	not				20°	40 ft.	
	677	" " " " ½ way	"	67,000	+	+	yes					24 ft.	
	678	" " " " ¾ "	"	96,000	+	+	"					22 ft.	
	679	" " " " 100' from Jersey Shore	"	86,000	+	+	"					13 ft.	
...t.27	680-684	Old reservoir Central Park	Surf to 5'	67,000 to 420,000 +	+	+	not					12 ft.	
Total	Samples	42 in Sept.											
...d.1	68-	Gowanus Canal Degraw St.	Surf	19,000,000	+	+	yes				25°	15 ft.	
	686	" " Union St. Bridge	"	13,000,000	+	+	"					15 ft.	
	687	" " Carroll St. "	"	11,000,000	+	+	"					11 ft.	
	688	" " 3rd st. "	"	10,000,000	+	+	"					13 ft.	
	689	" " Ham. Av. "	"	7,300,000	+	+	"				23°	15 ft.	
	690	" " Bay center	"	6,700,000	+	+	"				22°	22 ft.	
	691	Anchorage Spar Buoy "A" off Conover St.	"	2,000,000	+	+	"					23 ft.	

...3K.

Ex. 14 - P. 16

(11)

Date 1907	Sample Number	Location	Depth of sample	Bacteria per gram	Presumptive B. Coli .1cc.	Presumptive B. Coli 1cc.	Putrescible	Loss on Ignition	Color	Odor	Water Temp	Water Depth	Remarks.
Oct. 1	692	Anchorage 1200' from Erie Basin	Surf	2,400,000	+	+	Yes					15 ft.	
	693	" 1200' off Gowanus Bay	"	4,900,000	+	+	"					13 ft.	
	694	" 1200' " 39 St. Bklyn	"	4,500,000	+	+	"					17 ft.	
	695	" 1200' " 65 " "	"	4,000,000	+	+	"					20 ft.	
	696	" 1200' " 79 " "	"	3,500,000	+	+	"					19 ft.	
	697	Foot 65 St. Bklyn 100' from Sewer	"	8,000,000	+	+	"					15 ft.	
	698	" 49 " "	"	6,500,000	+	+	"					20 ft.	
Oct. 2	699	Anchorage Bklyn near Buoy "14 N.B."	"	640,000	+	+						15 ft.	
	700	" " " Buoy 5 & off 22 St	"	2,500,000	+	+						15 ft.	
	701	" " " E.S. off 60 St.	"	4,700,000	+	+						18 ft.	
	702	" " " N.S. 39 St.	"	1,700,000	+	+						14 ft.	
	703	" " " N.S. off 49 St	"	2,000,000	+	+						15 ft.	
	704	" " ½ way bet Buoy "14" & Gowanus	"	3,100,000	+	+						11 ft.	
	705	" " N end 500' S Buoy S.A.	"	1,900,000	+	+						15 ft.	

Total 21 Samples in October.

THE PEOPLE OF THE STATE OF NEW YORK,
COMPLAINANTS,

VS.

STATE OF NEW JERSEY ET AL.

COMPLAINANTS' EXHIBIT No. 15.

JAMES D. MAHER,
Commissioner.